Heating Piping & Air Conditioning

JUNE 1958

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. . . for Consulting Engineers • Mechanical (Heating, Piping, and Air Conditioning) Contractors • Engineers with Plants and Big Buildings

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- **York offers the broadest range of capacities in the industry — 18 to 246 tons!**
- **Completely integrated components cut installation costs! Exclusive Flooded Cooler design cuts operating costs!**
- **Exclusive capillary oil return insures trouble-free operation at all load conditions!**

York makes news again — with a series of packaged water chillers designed to cut the costs and simplify the process of air-conditioning. These advanced units lead the field in immediate and long-term benefits both for you and for your clients:

FAST, EFFORTLESS INSTALLATION! The complete system is shipped to you on a single skid. Needs no special foundation. Most sizes can be moved through ordinary doorways. The unit comes complete with insulation, interconnecting piping, and automatic control center. To start up: just charge with refrigerant *by sight*, hook up to power and water supply — and your unit's in business.

LOW-COST, TROUBLE-FREE PERFORMANCE! These features are exclusive with York: *Flooded Coolers* and *positive refrigerant feed control* in all models assure top efficiency and maximum heat transfer over the entire range of load conditions. Positive, *direct oil return* from chiller to compressor completely eliminates the danger of interrupted flow under light loads. Automatic capacity controls save power by continuously adjusting compressor output to prevailing load conditions — without supervision.

SAVINGS IN MAINTENANCE! All components and wearing parts are readily accessible for inspection and maintenance. Tube cleaning of *both* cooler and condenser waterside is greatly simplified because all surfaces are easily reached from either end. And, of course, York's famous Certified Maintenance Service is available anywhere.

Figure for yourself the savings in dollars and man-hours engineered right into this unit. It's another example of York's tradition of designing with the *real cost* of air-conditioning in mind. Consult your classified directory for the name and address of your local York sales representative . . . or write for Bulletin I-213 — which includes simplified specification tables. York Corporation, York, Pennsylvania.

YORK
CORPORATION
SUBSIDIARY OF BORG-WARNER CORPORATION
IN CANADA: CANADIAN ICE MACHINE COMPANY LTD., TORONTO

Millions Live Better with York

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A $250,000 Performance Bond backs every published rating of DeBothezat Fans so you can be certain of their actual on-the-job performance. Ratings are obtained from tests on *completely assembled* fan units in DeBothezat's own advanced laboratories. Accurate wind tunnel tests are made in accordance with the appropriate NAFM plate . . . conform to U. S. Dept. of Commerce Standard 178-51. Specify DeBothezat and you never have to make allowances "to be on the safe side."

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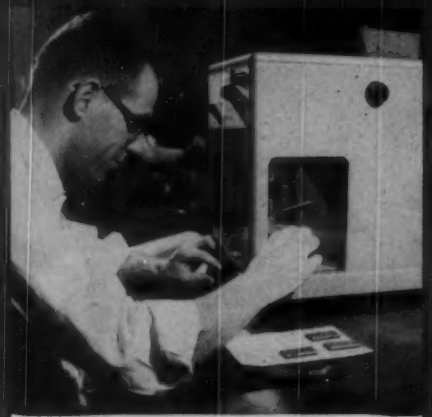
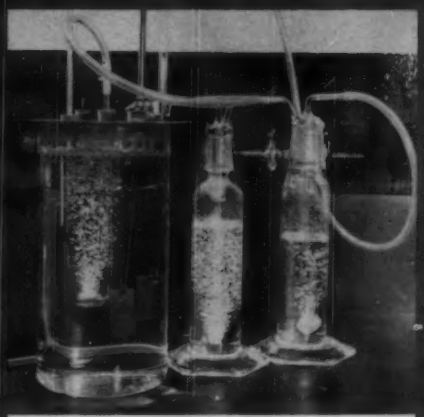
FOR FURTHER INFORMATION SEE OUR CATALOG IN SWEET'S OR WRITE FOR COPY

For further information, see our section in Sweet's Plant Engineering or Industrial Construction Catalog, or write for copy.



1 Analytical weighing of specimens prior to testing



2 Steam condensate corrosion test

3 Cleaning specimens with inhibited hydrochloric acid

4 Second analytical weighing to determine corrosion weight loss

5 Calculation and statistical analysis of laboratory test results

6 Final examination of specimens under low power magnification

Extensive testing program proves new 4-D Wrought Iron more corrosion-resistant than ferrous substitutes

Test results from the Byers Research Laboratory lend documentary support to the superiority of new 4-D Wrought Iron—over standard Wrought Iron as well as ferrous substitutes.

Convincing case-history service records are now further substantiated by the conclusive findings of our metallurgical staff. Some typical results of this testing program are presented in the chart at right.

The Byers field service representative will be pleased to relate these test results to your corrosive applications. Write us for helpful literature on new 4-D Wrought Iron. A. M. Byers Company, Clark Building, Pittsburgh 22, Pennsylvania.

BYERS WROUGHT IRON

Comparative Analysis of 4-D Wrought Iron Corrosion Tests

Tests	4-D Wrought Iron	Standard Wrought Iron	Ferrous Substitutes
Severe industrial atmospheric continued exposure 17 years	Corrosion weight loss 540 grams/sq. ft.	Corrosion weight loss 655 grams/sq. ft.	Not included in test
Steam condensate return line	*At least 25% greater corrosion-resistance than standard Wrought Iron	No failures 10 years (still in service)	Complete failure after 2 years
Aerated salt water—5 weeks (Short term test—points indicate 4-D Wrought Iron curve flattening out at much lower rate of attack)	Corrosion weight loss 146 mg/sq. in.	Corrosion weight loss 170 mg/sq. in.	Corrosion wt. loss 226 mg/sq. in.
Brine piping	*At least 25% greater corrosion-resistance than standard Wrought Iron	No failures 23 years (still in service)	Complete failure after 7 years
Salt water, Gulf of Mexico ¼ inch plate—17 years	Corrosion weight loss 4 mills/years (minimum plate thickness now 3/16") Still in excellent condition	Not included in test	Corrosion weight loss 30 mills/years; plate badly pitted, perforated
Downspout	*At least 25% greater corrosion-resistance than standard Wrought Iron	No failures in 29 years (Still in service)	Complete failure after 18 years

*In this application no long term test data yet available on 4-D Wrought Iron. Results shown are derived from short term tests.

Heating Piping & Air Conditioning

Vol. 30, No. 6

(With which is merged the Aerologist)

for CONSULTING ENGINEERS, MECHANICAL (heating, piping, and air conditioning) CONTRACTORS, and ENGINEERS WITH PLANTS AND BIG BUILDINGS

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Why Every Steam Heated Unit Needs its Own Steam Trap

. . . the theory, practice and proof of "unit trapping" for top temperatures

Using an individual trap for each steam heated unit, including each separate coil, chest or chamber of a machine—pays off for the user. Here are just two examples:

1. On a creamery dryer

Drainage Method	*Air Temperature*
Restricted Blow-thru	250°
Group trapping (1 trap for 8 coils)	225°
Armstrong Unit Trapping (8 traps—1 for each coil)	**309°**

2. On a platen press

Drainage Method	*Processing Time*
Restricted Blow-thru	50 minutes
Group Trapping	35 minutes
Armstrong Unit Trapping	**25 minutes**

Why Unit Trapping Works Best

It is reasonable to assume that no two steam heated units will have *identical* condensing rates. Even the slightest difference in rate will cause a difference in steam pressure drops through the units. Here's where the trouble starts. Condensate from each unit may flow to the trap. But, what about air and other non-condensibles in the system? A difference in pressure drops too small to be indicated by an ordinary pressure gauge will permit backflow of steam from the higher pressure units to the lower pressure units. This backflow of steam may even impede flow of condensate from the lower pressure unit to the trap . . . and it will definitely impede or block off flow of air to the trap. The result is sluggish heating, reduced temperatures, reduced output, fuel waste and increased possibility of corrosion. Figures 1, 2 and 3 diagram the action.

Unit Trapping Not Costly

No engineer wants any more mechanical devices in his plant than are absolutely necessary. But, the moderate additional cost of using two or more small traps, instead of one big one, is saved over and over again in improved efficiency.

If the traps are Armstrong, maintenance is no problem. And users frequently tell us that Armstrong traps outlast others two and three to one.

Steam traps usually represent a fraction of 1% of the cost of the equipment they drain. Does it make good sense to lose 10% or more of equipment capacity to save a few dollars on traps?

Why not test Armstrong unit trapping in your plant. If you are not completely satisfied with the results you can return the traps for a full refund of the purchase price. There is little to lose—lots to gain. Call your local Armstrong Factory Representative or Distributor, or write **Armstrong Machine Works, 8746 Maple St., Three Rivers, Mich.**

ASK FOR the 44-page Steam Trap Book and reprint of article on Unit Trapping.

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ARMSTRONG STEAM TRAPS

How Different Condensing Rates Can Slow Production

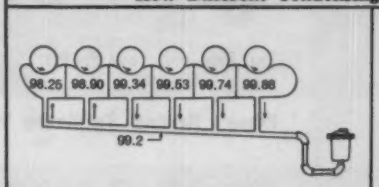

Fig. 1 This is a 6-roll ironer shortly after it has begun operating on 100 psi steam. When cold, wet material passes over chest 1, steam condensing rate is high and pressure drops accordingly. The pressure drop in chest 2 will not be as great, and so on down the machine as the material becomes progressively hotter and drier. Average pressure in the chests then is 99.27 lbs., and drain header pressure is slightly less, about 99.2 lbs. Under these conditions, steam from drain header enters chests 1 and 2 (as indicated by arrows at side of drain lines) because of pressure difference. Though condensate from chests drains by gravity, air can't leave chests countercurrent to incoming steam. Fig. 2 shows what happens next.

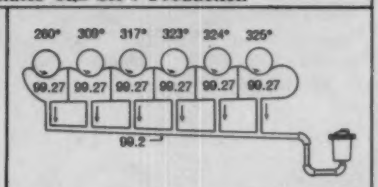

Fig. 2 This is the same 6-roll ironer after it has been operating a while. Air has accumulated in chests 1 and 2, reducing condensing rate and decreasing pressure drop. This process repeats itself down the line until pressures are as shown—that is, enough air will accumulate in each chest so that condensing rates and pressure drops of all chests will be about equal. The net result is shown in chest temperatures which are actual pyrometer readings taken on a 6-roll ironer, drained by a master trap, in a Chicago laundry. The laundry was making 337.9°F steam, but getting an average of only 309.6°F from the ironing surfaces, necessitating slow operation and frequent reruns. Then they tried Armstrong unit trapping—see Fig 3.

How Unit Trapping Prevents Trouble

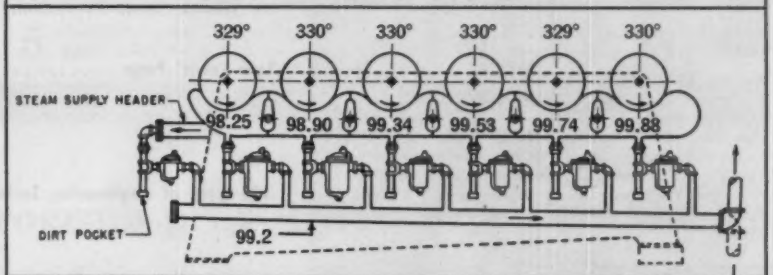

Fig. 3 This is the same 6-roll ironer, now unit trapped. Temperatures shown are also actual pyrometer readings—the average of 329.6°F is 20° higher than with group trapping. This is because air is continually removed from each chest into the drain header, and cannot get back into any chest.

MOTEL OWNER EXPLAINS WHY -

ALL-COPPER PLUMBING IS A SOUND BUSINESS INVESTMENT

The new 24-unit, 2-story "3 Judges" Motel, just off the famous Wilbur Cross Parkway, at New Haven, Conn. Architect, Caproni Associates, New Haven; consulting engineer, R. S. Leigh, Woodbury; plumbing contractor, J. V. Ursini Co., New Haven.

The light weight of copper tube makes it possible to pre-assemble sections. Units like this, or even larger, can be handled and set in place easily.

"SOUND, but economical, construction and low maintenance cost are two important factors in achieving reasonable returns from an investment in the motel business," says Stephen Nichols, owner of "3 Judges" Motel.

"That is why we wanted copper tube used for the plumbing, including all the sanitary drainage lines. We eliminate future repair and replacement expenses due to rust. With smooth copper tube there is much less chance of clogged lines. And we made savings in construction costs because extra wide plumbing walls were not needed."

OWNER, BUILDER, CONTRACTOR—all benefit when the use of copper tube for plumbing includes the sanitary drainage system and these benefits apply whether it is a commercial building, a housing development or a single home.

Plumbing contractors report that roughing-in is faster; their men like to work with copper for it is easier to handle and makes a neater job.

Builders say that by using the space-saving, trim copper tubes and compact solder-joint fittings they can locate bathrooms and utilities where desired without complicated and expensive construction to provide the extra space needed for the installation and maintenance of heavier and bulkier piping.

Copper tube and solder-joint fittings make a compact, space-saving installation. A 3" copper tube with fittings can be installed within a standard 4"-wide partition.

Owners have assurance of freedom from rust troubles, and homes with copper plumbing have higher resale values.

Anaconda Copper Tubes—Types K and L for water supply and heating lines; Type M and the new lighter weight Type DWV for the sanitary drainage system. Anaconda wrought and cast solder-joint fittings in types for pressure and drainage applications. Write for booklet—Anaconda Publication C-33. Address: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

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sets the "Pattern for Progress" in air conditioning with another tremendous new line...
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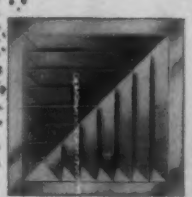
designed by TITUS



Here's today's most beautiful new line of diffusers . . . for today's most beautiful ceilings. Their distinctive styling brings a crisp freshness of design to any interior . . . yet blends diffusers unobtrusively into any decor.

AND THERE'S PERFORMANCE TO MATCH THIS BEAUTY! New, ingenious, built-in vane and louver arrangements provide a level of air diffusion efficiency seldom equalled. *ACTUALLY GIVE ARCHITECTS AND ENGINEERS NEW DESIGN FREEDOM* because diffusers can be placed in nearly any ceiling location . . . without the use of baffles and blank-offs.

Series TMD diffusers are available in types, sizes, patterns to fit every conceivable ceiling installation . . . any shape or size space.

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Company

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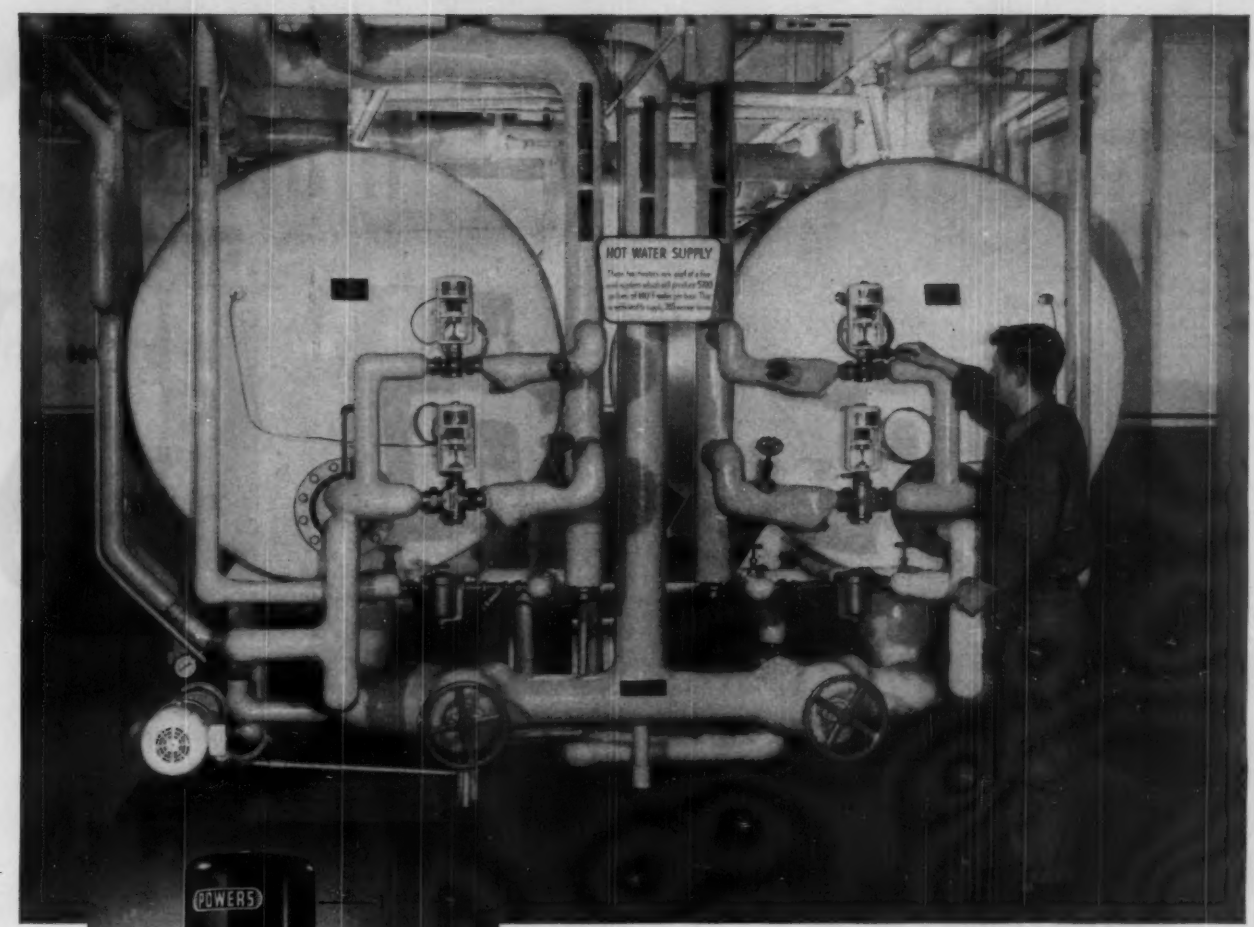
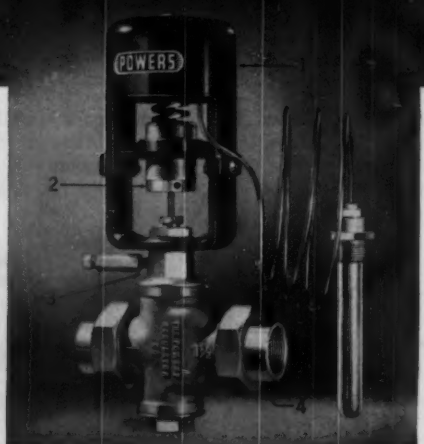
City State

You can specify or install POWERS





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1) Long lasting 2 ply bellows has more power than majority of regulators, also has overheat protection.

2) OILITE thrust bearing for easy temperature adjustment.

3) Valve stem Lubricator with Silicone grease, Powers 590-LONG-LIFE valve packing and polished stainless steel stem prevent binding of valve stem and greatly reduce packing maintenance.

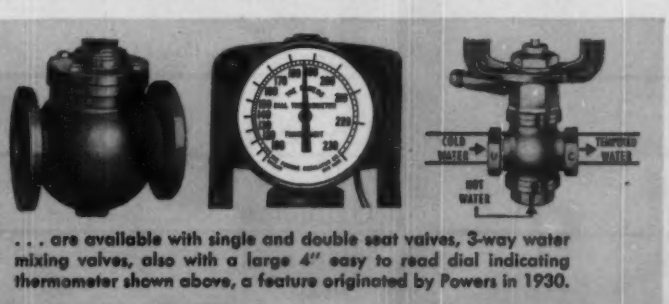
4) Bronze union connections, easy to install.

PRUDENTIAL INSURANCE COMPANY'S Mid-America Home Office Building, Chicago—depends on POWERS No. 11 Temperature Regulators to control the seven water heaters which supply general service Hot water throughout the building.

Two of the heaters, shown above, are located in one of the most colorful and attractive machinery rooms in America. They are part of a 5 unit system which produces 5700 gals. of 140° F water per hour.

Dual Control gives better regulation with widely varying demand.

POWERS No. 11 Self-Powered Temperature Regulators—



. . . are available with single and double seat valves, 3-way water mixing valves, also with a large 4" easy to read dial indicating thermometer shown above, a feature originated by Powers in 1930.

Temperature Control with Confidence

in its year after year DEPENDABILITY

Prudential's Mid-America Home Office
Architects and Engineers: NAESS & MURPHY
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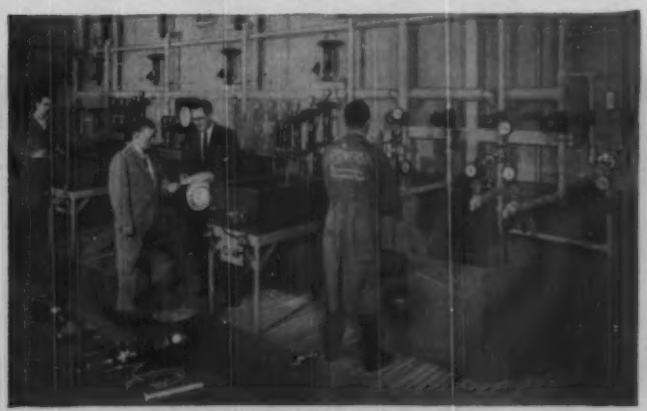
After 15 to 25 years of dependable service thousands of Powers temperature controls are still in operation. A 33 year old installation of Powers air operated No. 10 Regulators on 6 large water storage heaters are still in operation at Chicago's famed Palmer House hotel. Maintenance has been negligible.

With today's high cost for maintenance Powers time proven QUALITY controls are a better investment than ever before.



POWERS Temperature Control Specialists work with unexcelled testing and research facilities. Top flight engineers and technicians are constantly testing and improving the quality and performance of Powers products. New advanced designs of equipment also are being developed to maintain Powers leadership in the field of water temperature control.

Use Powers 65 Years of Experience and engineering know how to help you select the right type of temperature control and the right size valve. Both are essential for best control.

A nearby Powers factory and field trained engineer will gladly assist you. There's no obligation. *Call our Nearest Office or Write us direct.*

THE POWERS REGULATOR CO.
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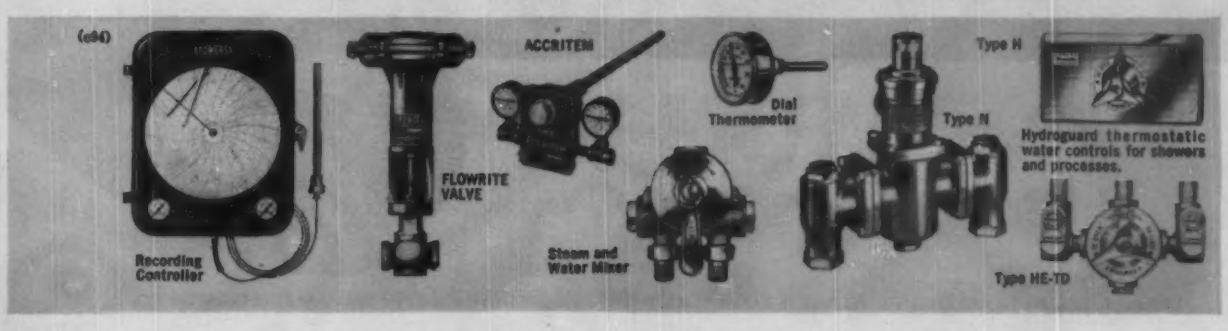

In Iron Body Wedge Gate Valves,
Outside Screw and Yoke Design,

Walworth offers you these 8 outstanding advantages!

STRONGER CONNECTIONS. T-head disc-to-stem connection on OS&Y types permits wedge to properly seat itself.

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SURE-GRIP HANDWHEEL. Fluted design assures a sure grip, even with greasy gloves.

HIGH CORROSION RESISTANCE. Brass liner protects glands from deterioration and scoring.

EASIER REPACKING. Hinged gland eye-bolts on OS&Y valves permit fast maintenance under full pressure.

LESS DAMAGE. Bronze back-seat bushing in bonnet of OS&Y valves prevents scoring, guides stem accurately.

Walworth Iron Body Gate Valves are available with screwed or flanged ends, in sizes and types for every purpose. For full information see your Walworth Distributor or write: *Walworth Company, 750 Third Avenue, New York 17, N. Y.*

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60% shorter– but with radial air-gap design!

New Louis Allis Pancake Motor preserves all the advantages of conventional motor construction

The new Louis Allis Pancake Motor is your solution to trouble-free power in any space-cramped motor application.

The Pancake is a remarkably short flange-mounted motor — up to 60% shorter and 33% lighter than standard motors of the same rating! And it is built in *conventional* radial air-gap design!

It's done by an ingenious forming process which literally compresses the end coils of a conventional radial air-gap motor into an exceptionally short length. The result is a compact, light motor ideally suited for horizontal or vertical mounting on machine tools, roof ventilating fans, or *any* close-quarter installation where space is a critical design factor.

What's more, this is achieved without sacrificing a single desirable characteristic: the stator still contains the same iron and copper as standard Louis Allis motors . . . standard NEMA service factor is maintained . . . high insulative values are retained by using proved Louis Allis varnishes and new insulating techniques . . . over-sized pre-lubricated bearings are used to guarantee long bearing life . . . and the entire motor is enclosed in an industrial-type cast-iron housing designed to shrug off abuse!

The housing and flange are cast in one piece: this permits extra-accurate internal machining which extends bearing life and reduces noise levels to a new low.

Investigate the Pancake Motor through your local Louis Allis District Office. Sized from 1 to 15 hp, at 1800, 1200, and 900 rpm, in open drip-proof and enclosed non-ventilated or fan-cooled enclosures. Write for Bulletins 2100 and 2150 to the Louis Allis Co., 453 E. Stewart St., Milwaukee 1, Wis.

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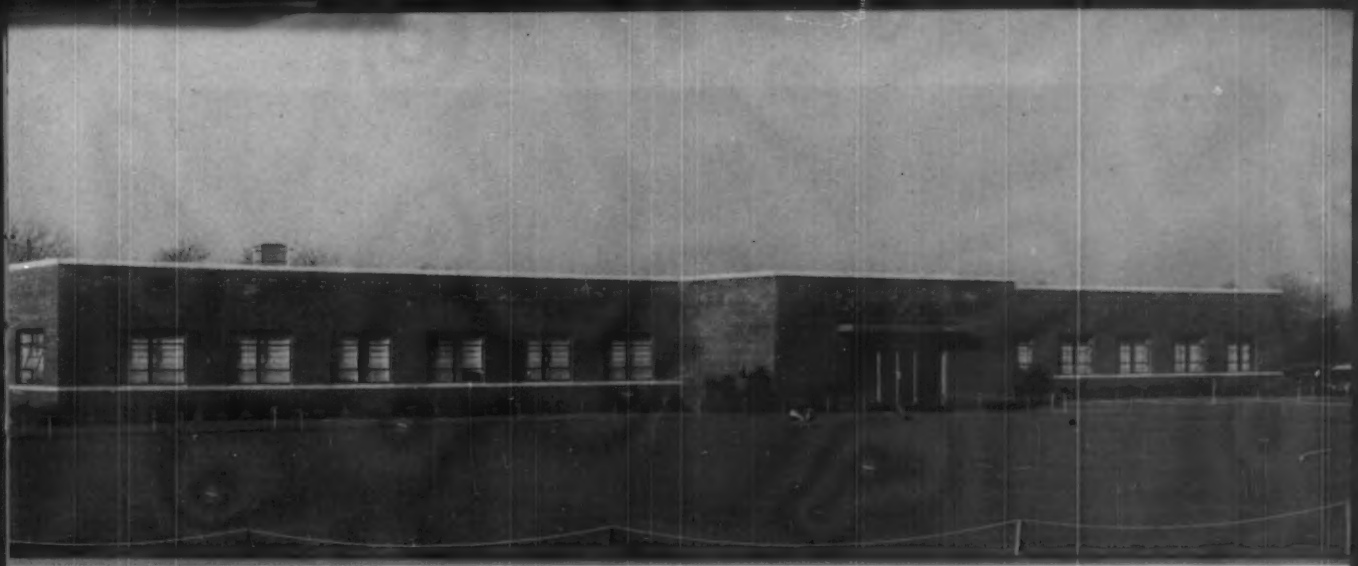
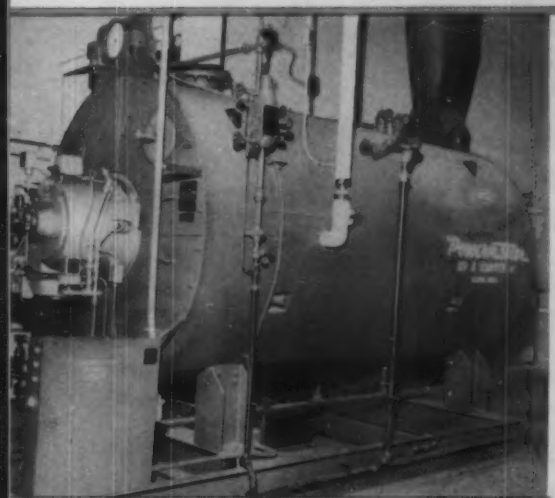
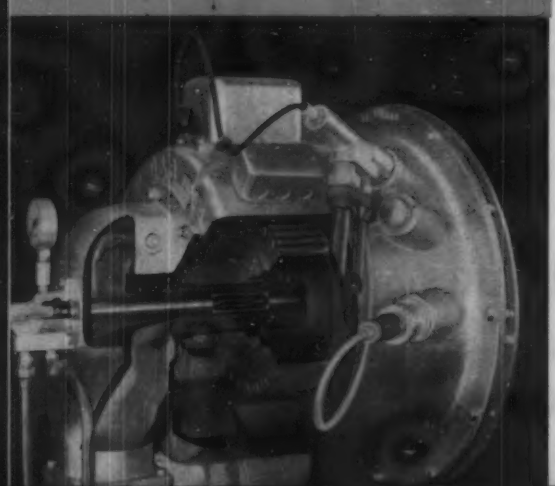


How modern million-dollar plant gets dependable, low-cost steam heat



150 hp *Powermaster* completely factory packaged and fire-tested boiler in the above plant. Note simplicity, compactness and cleanliness.

Cutaway view of O&S air-atomizing oil burner. Note simple rugged construction, free of troublesome moving parts.



This attractive, modern building in Connecticut is the home office and production headquarters for a prominent manufacturer of electronic dictating and recording equipment. Emphasis on efficient, cost-saving operation and services is evident throughout the plant and office.

Heating is no exception. Low-cost, dependable heat is assured throughout the entire building by steam from the 150 hp *Powermaster* Packaged Automatic Boiler shown below. It is fired with heavy residual No. 6 oil. Complete, clean and efficient combustion with this economical high-heat fuel is an outstanding advantage of *Powermaster*. Its low-pressure, air-atomizing oil burner is the secret. Designed by O&S expressly for burning heavy as well as light oils, it provides trouble-free, highly efficient combustion with No. 6 Bunker C grade at all boiler loads from 20% to 100% of normal rating.

Besides fuel economy, *Powermaster* brought other cost-saving boiler-room advantages to this plant: Simple cost-saving installation, space-saving compactness, labor-saving automatic operation, fast steaming, instant response to load changes, clean, quiet operation, time-saving inspection and maintenance, and lasting dependability.

To be sure of getting the most for your boiler dollars for heating or process steam with oil, gas or combination fuel firing . . . install *Powermaster*. It doesn't cost, it pays! Send for up-to-date bulletin.

Powermaster®

PACKAGED AUTOMATIC BOILERS

Sizes to 600 hp; pressures to 250 psi

Builders of Dependable Boilers Since 1885

ORR & SEMBOWER, INC.

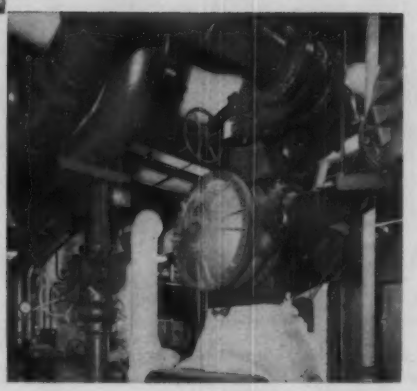
Morgantown Road, Reading, Pa.

Air Conditioning with

USS National Pipe—

Chicago's Field Building

One of Chicago's landmarks, the towering Field Building on South LaSalle Street, recently completed the installation of a new air-conditioning system. USS NATIONAL Seamless Steel Pipe was used throughout the system—a total of 127 tons of it—in sizes from 3" O.D. to 18" O.D.



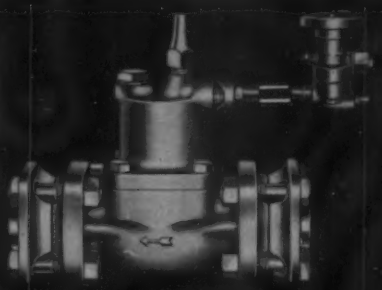
Need first-quality pipe for air-conditioning, heating and power installations? Need seamless steel pipe that will pay you back in outstanding service many times over for every dollar you spend? Then just say "NATIONAL Seamless." And, for further information or immediate assistance with your pipe problems, write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

USS and National are registered trademarks

"The world's largest and most experienced manufacturer of tubular products—NATIONAL TUBE"

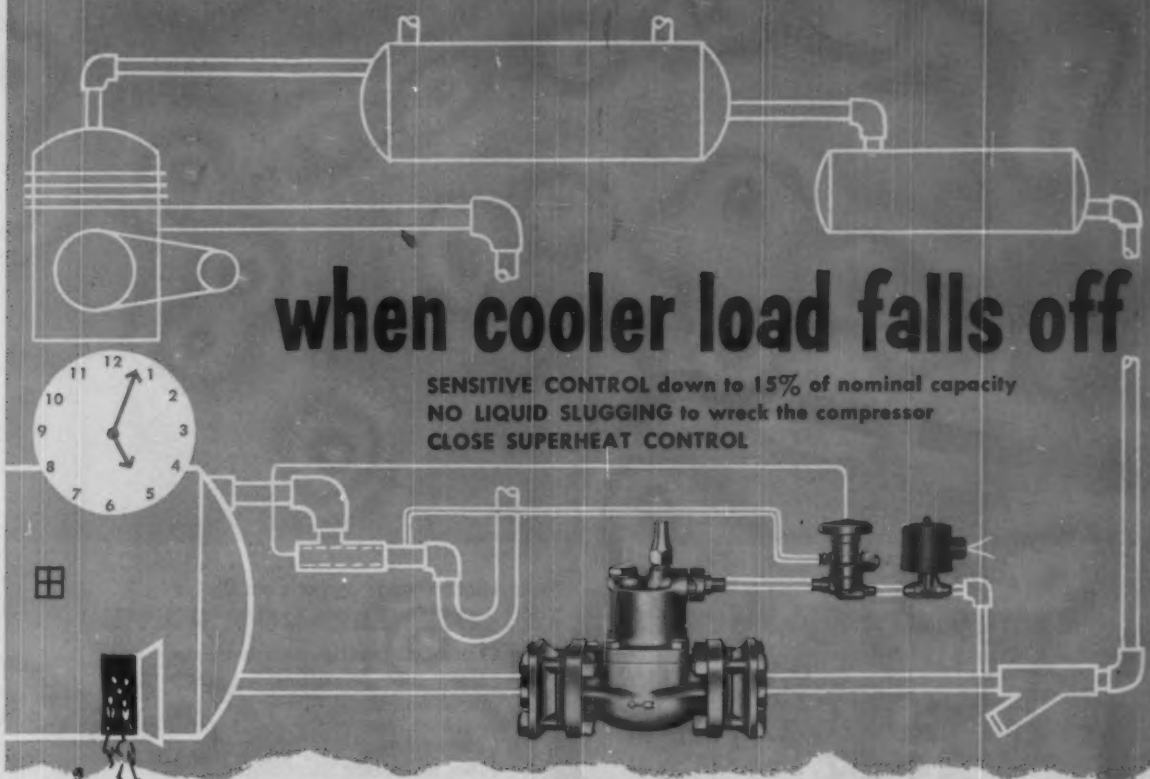
National Tube Division of USS United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors • United States Steel Export Company, New York



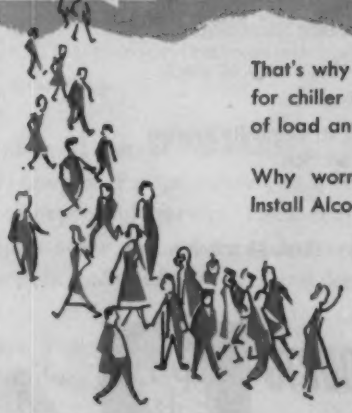
alco's PO valve

maintains control



when cooler load falls off

SENSITIVE CONTROL down to 15% of nominal capacity
NO LIQUID SLUGGING to wreck the compressor
CLOSE SUPERHEAT CONTROL



That's why Alco is recommended so often for chiller applications with wide ranges of load and capacity.

Why worry about compressor failure? Install Alco and relax!

Capacities: 20 to 200 tons, F-12 and F-22

Buy Alco . . .
The System Shows the Difference

Write for Bulletin No. 189-57

The one complete line of refrigerant controls that insures product quality: Thermostatic Expansion Valves, Refrigerant Distributors, Solenoid Valves, Suction Line Regulators, Flooded Evaporator Controls, and Reversing Valves.

ALCO VALVE CO.
861 KINGSLAND AVE • ST. LOUIS 5, MO

7600

SEE YOUR ALCO WHOLESALER

SPECIFY COPPER TUBE AND PIPE MADE THE QUALITY WAY...

MADE IN U.S.A.

BECAUSE:

- You are assured of *consistent* quality time after time.
- You support your fellow American workers.
- You help build your reputation and America's prosperity.
- You can count on a reliable source of supply.

TYPES K, L, M, DWV, COPPER AND BRASS PIPE

The All-American Line From Mine to Market

PHELPS DODGE COPPER WATER TUBE

- Highest grade copper from Phelps Dodge's own mines.
- Controlled quality assures unsurpassed tube properties, including precise uniformity of wall thickness.
- Color-coding of straight-length tubes for instant identification.
- Packaging that's easy to stock, easy to use.
- Mill depots strategically located for speedy service.

Quality tube sold the Quality way—through wholesalers

PHELPS DODGE COPPER PRODUCTS CORPORATION

NEW YORK, N. Y. • LOS ANGELES, CALIF.

MADE IN U.S.A. TO THE STANDARDS OF AMERICAN INDUSTRY

WHEN YOU USE "BUFFALO" CLOSE-COUPLED PUMPS

"Buffalo" CCL Close-Coupled Pumps can't be beat where space is limited. They are easy to install with permanently aligned shafts and adjustable discharge angle. This provides extreme adaptability in piping and mounting.

Thanks to 81 years of engineering experience, "Buffalo" Close-Coupled Pumps insure you a long, trouble-free life of dependable service. Their rugged construction includes heavy cast mounting brackets, sturdy shells, accurately machined impellers, and deep stuffing boxes.

Where you need space-saving pumps, designed to deliver *extra* years of clear water service, be sure to use "Buffalo" CCL Close-Coupled Pumps, capacities to 1100 GPM. Bulletin 975-D gives you full information. Write for it today.

You're assured of value in "Buffalo" products by the "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.

BUFFALO PUMPS
DIVISION OF BUFFALO FORGE CO.
171 MORTIMER STREET • BUFFALO, N. Y.
Canada Pumps Ltd., Kitchener, Ont.
Sales Representatives in All Principal Cities

"Buffalo" PUMPS

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

Now

ANEMOSTAT®

presents

Standardized Constant Volume

TURBULATORS

The Anemostat Constant Volume Turbulator is a standardized high capacity dual duct unit handling from 800 to 7000 CFM. It provides an economical solution to many air distribution problems in which a large volume of air at controlled volume or pressure, and temperature, is involved.

With the Anemostat system, all thermal functions—heating—cooling—ventilating—are accomplished with air. Coils and resultant coil lag are eliminated together with required piping. Pressure losses are low and so are noise levels. Quality-built Anemostat Turbulators function automatically. They are easy to install, simple to maintain.

Anemostat Constant Volume Turbulators provide zoning up to 7000 CFM with one set of controls—save money by replacing coil reheat zone-control with all-air system.

New Bulletin gives important engineering data on Anemostat Constant Volume Turbulators. Write for your copy today.

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ANEMOSTAT CORPORATION OF AMERICA

10 EAST 39th STREET, NEW YORK 16, N. Y.

REPRESENTATIVES IN PRINCIPAL CITIES

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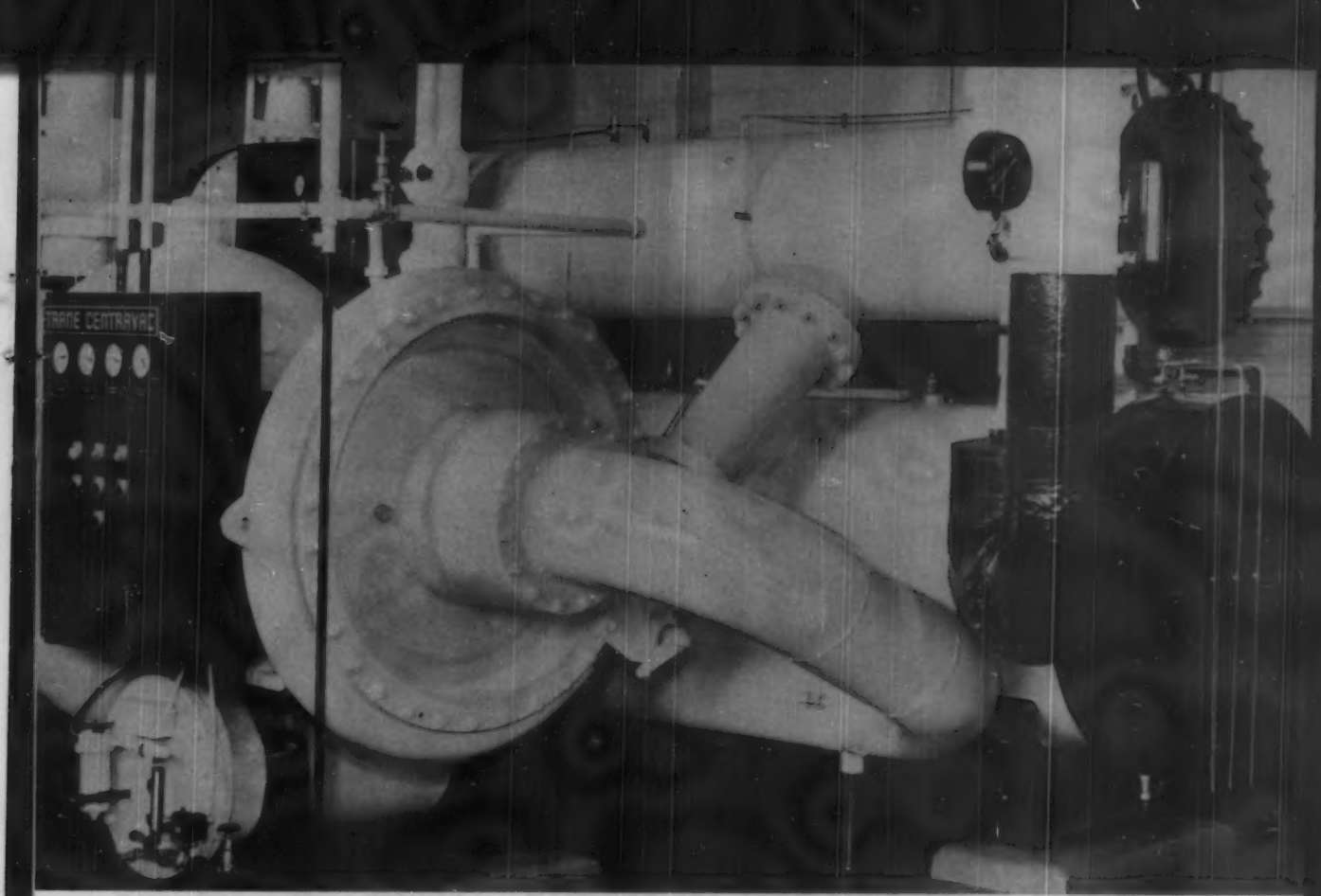


Thrifty Trane CenTraVac provides chilled water at low cost

You'll cut air conditioning costs if the water chiller you select is a rugged, dependable TRANE CenTraVac.

Whether air conditioning is required for process or comfort, the CenTraVac provides the refrigeration needed, *automatically*—and it cuts power costs to the bone!

In operation, the CenTraVac paces itself to supply just the right amount of refrigeration. It automatically throttles down to within 10% of its capacity—*or even lower*—to meet part-load conditions. And it reduces power consumption in almost direct proportion to the load!

But saving is just a part of the CenTraVac story. This famous hermetic compressor has been refined and perfected to the point where it has become the standard of the industry. It's so versatile and compact you can install it anywhere from basement to rooftop—even out of doors! Units available for any big building comfort or process cooling job—in a complete range of sizes to 1500 tons. For complete facts on the TRANE CenTraVac, call your nearby TRANE Sales Office—or write TRANE, La Crosse, Wisconsin.

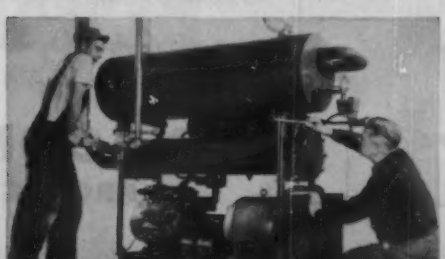
For any air condition, turn to

TRANE

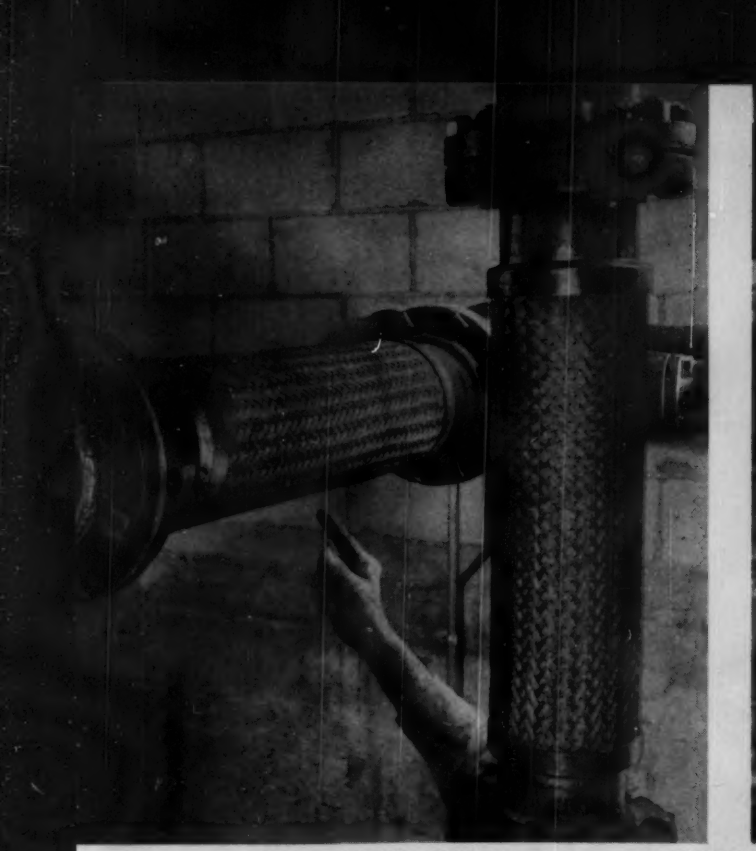
MANUFACTURING ENGINEERS OF AIR CONDITIONING, HEATING, VENTILATING AND HEAT TRANSFER EQUIPMENT

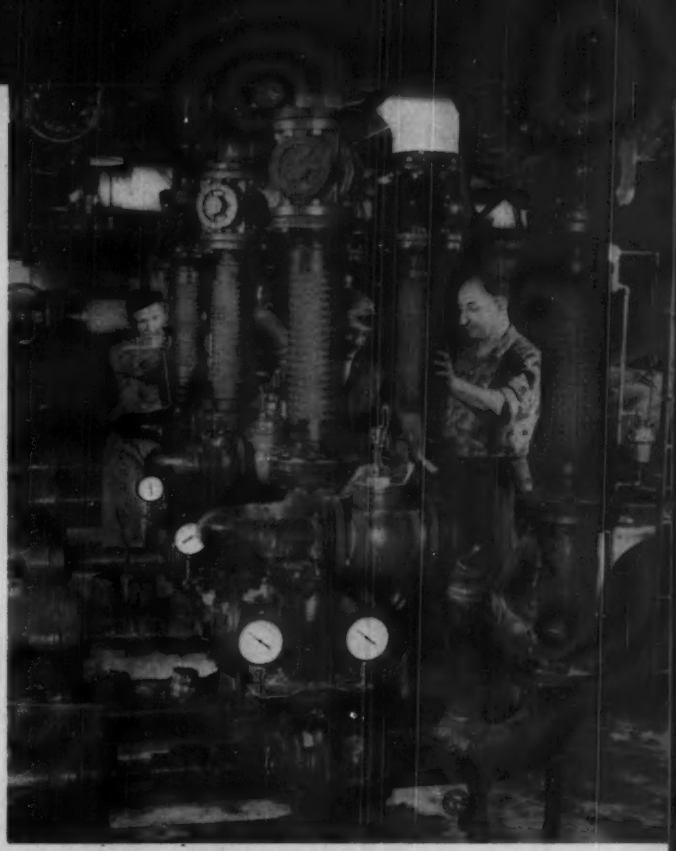
THE TRANE COMPANY, LA CROSSE, WIS. • SCRANTON MFG. DIV., SCRANTON, PA. • CLARKSVILLE MFG. DIV., CLARKSVILLE, TENN. • TRANE COMPANY OF CANADA, LIMITED, TORONTO • 97 U.S. AND 19 CANADIAN OFFICES

FOR SMALLER COOLING JOBS, make it a TRANE Cold Generator. Factory pre-assembled for fast, easy installation. Just a few simple piping and wiring connections to make. Compact, efficient units in sizes to 150 tons.



COOL OFFICES, tool rooms and other smaller areas with an economical, quiet TRANE Self-Contained Air Conditioner. Units come in a complete range of sizes from 3 to 20 tons; waterless models to 15 tons.





PHOTOS PROVIDED through the courtesy of GRAFLEX, INC., manufacturers of precision photographic, electronic and optical products, at the company's new multimillion-dollar Rochester, N. Y., plant.

New Flexpipe flexible bronze tubing isolates vibration, provides expansion joint for Graflex, Inc.

THE PROBLEM:

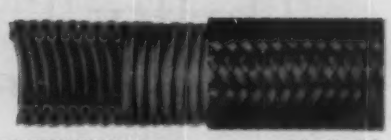
In a heating and air conditioning system, the temperature range of water and condensate varies over a 180°F. range. Some means were required to provide for expansion and contraction in the system without putting undue stress on rigid pipe and to confine the vibration to the compressors.

THE SOLUTION:

Use of new large-size (4", 5" and 6" I.D.) American Flexpipe — flexible bronze tubing assemblies complete with end fittings.

Flexpipe connectors — in standard sizes — can solve tough problems for you, too, wherever air, gas, oil, steam or water must be conveyed, because Flexpipe:

- Has extreme flexibility that lessens chances of breakage and leakage from expansion and contraction.
- Needs little maintenance attention.
- Dampens noise, absorbs vibration, takes up movement, solves misalignment problems.
- Cuts installation costs (does away with time and material costs of rigid conduit requiring elbows, couplings, short runs of pipe, etc.).
- Makes installations quick and easy —especially in cramped quarters.



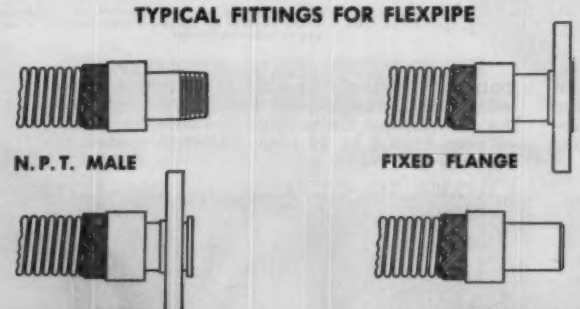
CONSTRUCTION: Inner hose corrugated for flexibility; wire braid over inner hose for added strength. Available in bronze, steel and stainless steel.

WHERE TO BUY:

Leading wholesaler distributors can provide you with information about Flexpipe in large sizes. These same distributors can show you samples and answer your questions about service applications for Flexpipe connectors in convenient standard sizes from ¾" up to 16" I.D. For the name and address of the distributor serving your area, or for more detailed information, write to: The American Brass Company, American Metal Hose Division, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

68167

TYPICAL FITTINGS FOR FLEXPIPE



(OTHER FITTINGS AVAILABLE)

Flexpipe®

AN

ANACONDA®

PRODUCT

Now! Lower operating costs with new

A pre-wired, pre-engineered package for regulating motor-driven fan heating units!

The new Illinois Night Control is the low-cost answer to effective off-hour control of motor-driven fan heating units. Perfect for heating or air conditioning systems in schools (including unit ventilator systems), churches, industrial plants, commercial buildings, shopping centers—any place where it's desirable to automatically adjust temperatures during unoccupied periods. No more expensive on-the-job wiring — Illinois Night Control contains everything in one compact, pre-wired cabinet.

HERE'S HOW IT WORKS — Illinois Night Control automatically shuts off heating unit fan motors—singly or in groups—when they are not needed during unoccupied periods. During these periods the area is heated by convection only until space temperature drops below the desired level. The control then starts the fan which operates until the proper temperature is reached. It's as simple as that!

Illinois Night Control works with normal temperature regulation to reduce needless system operation.

MAIL COUPON FOR MORE INFORMATION

Illinois Engineering Company
2035 South Racine Avenue
Chicago 8, Illinois

Please send me Bulletin No. 570 describing new Illinois Night Control.

Name _____

Firm _____

Address _____

City _____ State _____

illinois ENGINEERING

A product of Illinois Engineering Co.
2035 South Racine Ave., Chicago 8, Illinois
Division of American Air Filter Co., Inc.

"Glasfloss is the only filter of this type on the market that we know of which deals so effectively with the abnormal dust, moisture and velocity conditions under which our air conditioning system operates," says Mr. Harry Havekost of Sixty Wall Tower.

New Glasfloss Safety-Grille Filter has chipboard frame and grille which eliminates danger of cut hands and wrists when changing filters.

New Glasfloss® Fiber Glass Safety-Grille Filters pass critical performance tests at Sixty Wall Tower

"We tested the new Glasfloss Safety-Grille Filters in many critical locations in our building," reports Mr. Harry Havekost, Chief Mechanic in charge of air conditioning, Sixty Wall Tower, New York City. "The results were highly satisfactory."

"Our air conditioning system, operating at 375 to 650 ft/min air velocity, must filter out carbon and paper dust from business machines and dirt from nearby smoke stacks. We also suffer abnormal humidity conditions which cause separation of chipboard frames from metal grilles; this sometimes causes the fiber glass to blow out, impairing filtering efficiency.

"But the new Glasfloss Safety-Grille Filters proved themselves sturdier and more effective than the older-type metal grille filters. The strong, one-piece chipboard frame and grille construction gives a sturdy anchor to the fiber glass and prevents 'blow-outs.' We use two one-inch filters back-to-back in each panel. The grilles line up perfectly; there is no loss of available filtering area.

"Our maintenance men like handling the new chipboard Safety-Grille. Now, there is no danger of annoying cuts which were prevalent when we had to deal with fine-edged metal grilles."

TRY NEW GLASFLOSS SAFETY-GRILLE FILTERS IN YOUR SYSTEM

Get top filtering results—plus safety! Glasfloss Fiber Glass Safety-Grille Filters are available in a complete range of sizes. Call your nearest Glasfloss Distributor or PPG Warehouse for service.

A PRODUCT OF PITTSBURGH PLATE GLASS COMPANY

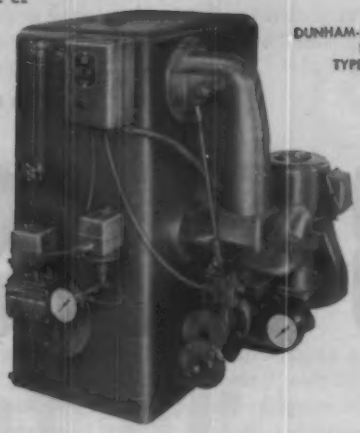
Sales Offices are located in the following cities: Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, Minneapolis, New York, Philadelphia, Pittsburgh and St. Louis

75th ANNIVERSARY 1883—1958 PPG

SYMBOL OF SERVICE FOR SEVENTY-FIVE YEARS

PITTSBURGH PLATE GLASS COMPANY

DUNHAM-BUSH VACUUM PUMP, DUPLEX UNIT, TYPE VRD, MODEL C2



DUNHAM-BUSH VACUUM PUMP, SINGLE UNIT, TYPE VR, MODEL C2

Only **Dunham-Bush Vacuum Pumps give you ALL these Features**

COMPARE THESE FEATURES	YOU Check ALL for Dunham-Bush Vacuum Pumps	How Many "Yes" Checks? Pump "A"	Pump "B"	Pump "C"
1. CAPABLE OF PRODUCING 26" VACUUM OR HIGHER AS STANDARD.	√			
2. NO CLOSE CLEARANCES REQUIRED TO MAINTAIN CAPACITY.	√			√
3. ONE PRINCIPAL MOVING PART.	√			√
4. ONLY ONE MOTOR FOR REMOVAL OF BOTH AIR AND CONDENSATE.	√		√	√
5. NO VACUUM ON PUMP STUFFING BOX.	√		√	√
6. "CODE RATED" GUARANTEEING ADEQUATE CAPACITY (AIR AND WATER)—NO NEED FOR OVER-RATING TO COMPENSATE FOR FUTURE WEAR.	√			√
7. HEAVY GAUGE COPPER BEARING STEEL TANKS FOR MAXIMUM RESISTANCE TO CORROSION.	√			
8. SINGLE AND DUPLEX—2500 THROUGH 65,000 EDR.	√	√	√	√
9. NO EXTRAS TO BUY, ALL STANDARD UNITS HAVE CONTROLS MOUNTED AND WIRED—DUPLEX HAVE MECHANICAL ALTERNATOR AS STANDARD EQUIPMENT.	√			
10. LOW LEVEL RETURN LINE CONNECTION. NO NEED FOR EXTENSIVE PITTING.	√	√		

You may get *some* of the ten important vacuum pump features in other pumps, but only Dunham-Bush gives you *all*.

The comparison chart tells the story!

No wonder top rated Dunham-Bush vacuum pumps have been delivering dependable performance . . . economical operation for years.

Get further proof why Dunham-Bush vacuum pumps are your best bet. Write for Bulletin 1401 or ask a Dunham-Bush sales engineer to call.

Dunham-Bush, Inc.

WEST HARTFORD 10 • CONNECTICUT • U. S. A.

DUNHAM-BUSH

AIR CONDITIONING • REFRIGERATION • HEATING • HEAT TRANSFER

WEST HARTFORD, CONNECTICUT • MICHIGAN CITY, INDIANA • MARSHALLTOWN, IOWA

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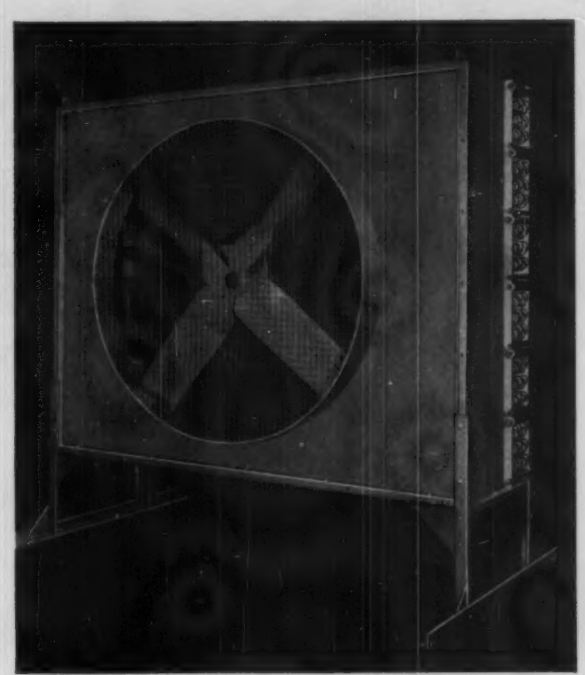
SUBSIDIARIES

9 - 11 - 15 - 20 - 25 - 30 - 40 - 50

NOW...

8 SIZES UP TO 50 TONS

In a Single Unit



McQuay "AB" Belt Drive AIRCON

Remote, waterless condensers available in eight sizes, 9, 11, 15, 20, 25, 30, 40 and 50 ton nominal capacities in individual units with single fan and motor assemblies. Coils constructed of copper tubes with McQuay Ripple Fins. Lifetime ball bearing and slow speed propeller type fan.

McQUAY AIRCON *Air Cooled Condensers*

Here is the finest, the most complete, most versatile, the most efficient line of remote air cooled condensers on the market, as well as the largest available in a single unit. There are eight McQuay "AB" Belt Drive AIRCON Air Cooled Condensers from 9 to 50 ton nominal capacities. McQuay also offers the "AD" Direct Drive AIRCON Line of Air Cooled Condensers in 2, 3 and 5 ton nominal capacities. All McQuay AIRCONS are designed for multiple circuiting so that two or more separate refrigeration systems can be connected to the same condenser.

PEAK PERFORMANCE ALL YEAR 'ROUND WITH "SEASONTROL" MODULATION.

The McQuay "Seasontrol" modulates the condenser capacity in accordance with the weather for proper operation at all times. There is a McQuay representative in every principal city, or write McQuay, Inc., 1601 Broadway St., N.E., Minneapolis 13, Minn.

McQuay Means Quality

McQuay INC.

MAKE THE SEASONS COME TO YOU

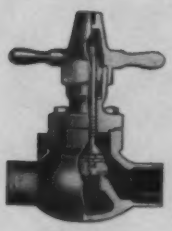
AIR CONDITIONING
HEATING
REFRIGERATION

"Golden Bantam" Packless Valve—Type 516

A small packless line shut-off valve with ¼" thru ⅝" flare, O.D.S. or extended end solder connections. Also "Blue Bantam" and "Standard" Balanced-Action packless line shut-off valves with ¼" thru ⅝" Fl. and ⅛" thru 1⅛" O.D.S. size connections.

Cross-Vu® Hermetic Seal Liquid Indicator

Brass indicator with glass fused directly to metal body. Maximum working pressure 500 P.S.I. Connection sizes: ¼" thru ⅝" M.Fl., M.Fl. x F.Fl. or with extended ends and solder connections.



Wing Cap Packed Valves—Type 203

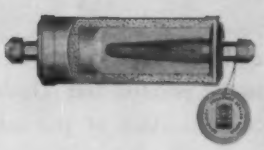
The standard of the industry. Bronze alloy with O.D.S. connections in sizes ⅛" thru 4⅛" (Globe) and ⅛" thru 3⅛" (Angle). Also semi-steel with ½" thru 2½" F.P.T. connections and semi-steel flanged type globe and angle valves with brass O.D.S. or steel butt-weld adapters, and one piece socket weld or F.P.T. flanges in a wide range of sizes from 1" to 5⅛".

HENRY *for low installation cost*

Angle Relief Valve—Type 52

UV ASME—NB—National Board Certified

Forged brass automatic pressure relief valve. Pressure setting range 50 to 450 P.S.I. Size connections: (M.P.T. Inlet x Flare Outlet) ¼" x ⅜", ⅜" x ⅜", ⅜" x ½" and ½" x ⅝". Also ⅜" O.D.S. x ⅜" O.D.S.



"DRI-COR" Filter-Drier—Type V800

Ceramic fired desiccant filter-core in bed of granular desiccant—a blend of molecular sieves and activated alumina. Provides high capacity drying even at relatively high temperatures, micronic filtration, efficient acid removal and low pressure drop. Pressure sealed. Wide range of sizes with ¼" thru ⅝" Fl. connections. "DRI-COR" Filter-Drier Cartridges also available for Henry Cartridge Type Angle Driers.

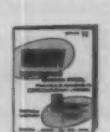
"Y" Strainer—Type 895

Flanged design permits cleaning without removing strainer from line. Screen cylinders securely located by spring tension preventing by-passing of refrigerant. Forged brass end caps with integral end connections. Screen area: 10 thru 150 sq. in. Size connections: ⅜" thru 4⅛" O.D.S. Angle and straight-through type strainers also available.

Write for catalogs describing the complete line.

Catalog 103
Valves, Driers, Strainers and Accessories.

Catalog 202
Ammonia Valves and Accessories.



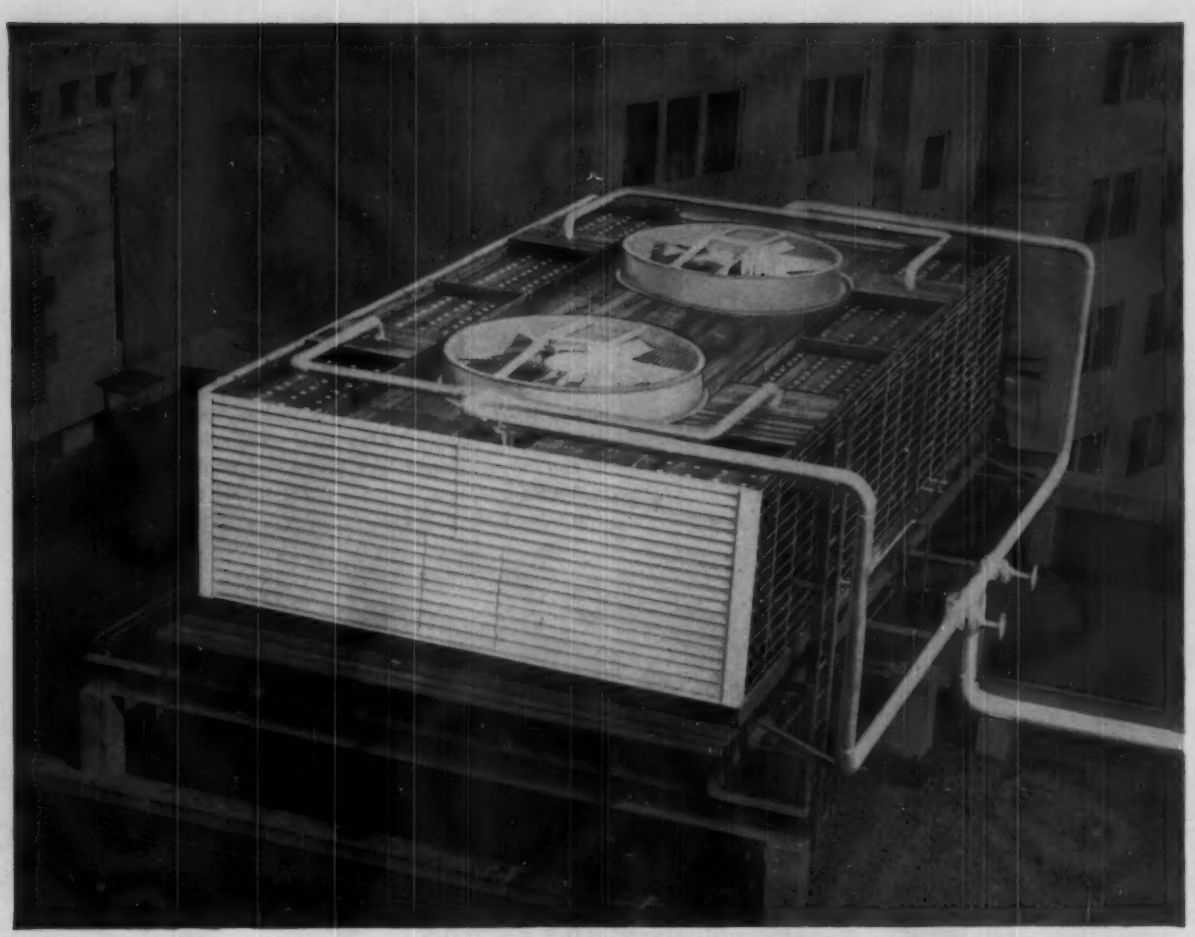
Catalog FF
Forged Carbon Steel Fittings.

HENRY VALVE COMPANY

Manufacturers of Valves, Driers, Strainers, Fittings and Accessories for Refrigeration, Air Conditioning and Industrial Applications.

3215 NORTH AVENUE, MELROSE PARK, ILLINOIS (Chicago Suburb)

CABLE: HEVALCO, MELROSE PARK, ILLINOIS



Dependability Demanded: Double-Flow Aquatower® Specified

THIS COOLING TOWER IS HOSPITAL EQUIPMENT and its selection was based on the rigid evaluation applied to the diagnostic, surgical and therapeutic equipment that makes Baptist Memorial Hospital, Memphis, one of the country's outstanding medical institutions. Demonstrated ability, dependability and low maintenance were the prime factors in pre-purchase analysis.

Investigation showed that thousands of Double-Flow Aquatowers are delivering completely satisfactory service to owners the world over. It placed them in every type of commercial, institutional and industrial operation—from air conditioning in the most modern buildings and stores throughout America to process cooling in a gold smelter in South Africa. The study pointed out Double-Flow Aquatowers as the standard of the intermediate capacity field.

You can verify this information readily for there are Double-Flow Aquatowers in service in your city, wherever it be. Ask the Marley Sales Engineer in your area for a list—he'll be glad to give the locations of these efficient performers. Be sure to get a copy of Marley Bulletin DFA-58 that gives complete information on this extensive line of cooling towers that offers towers of wood or steel structure in three size models—for single or multi-cell installation.

MARLEY

The Marley Company / Kansas City, Missouri

The motor with the built-in hush ...Westinghouse Life-Line A

Tests prove the Life-Line® "A" motor is the quietest available for air-conditioning applications and other places where motors must be quiet. Studies in soundproof laboratories prove the operating sound level of these Life-Line "A" motors is lower than any other standard motor.

Precision manufactured parts, dynamically balanced, assure dependable service. Possible vibration is minimized by rugged mounting of this smooth-running Westinghouse motor. Pre-lubrication coupled with Life-Line "A" fortified insulation and close-tolerance machining offers the nearest thing to a maintenance-free motor available.

For further information on the Life-Line "A" motor, call your Westinghouse sales engineer or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21998

YOU CAN BE SURE...IF IT'S Westinghouse

O-B VALVES

Meeting the need for low-cost maintenance

Contractors who install the new O-B composition disc valves are giving their customers a break on maintenance. Here's why:

1—The union bonnet ring makes dismantling and reassembling quick and easy when the valve has to be broken.

2—A slip-on disc holder permits disc changing with the least amount of trouble.

3—Repacking is accomplished with the valve in the full open position, without closing down the line.

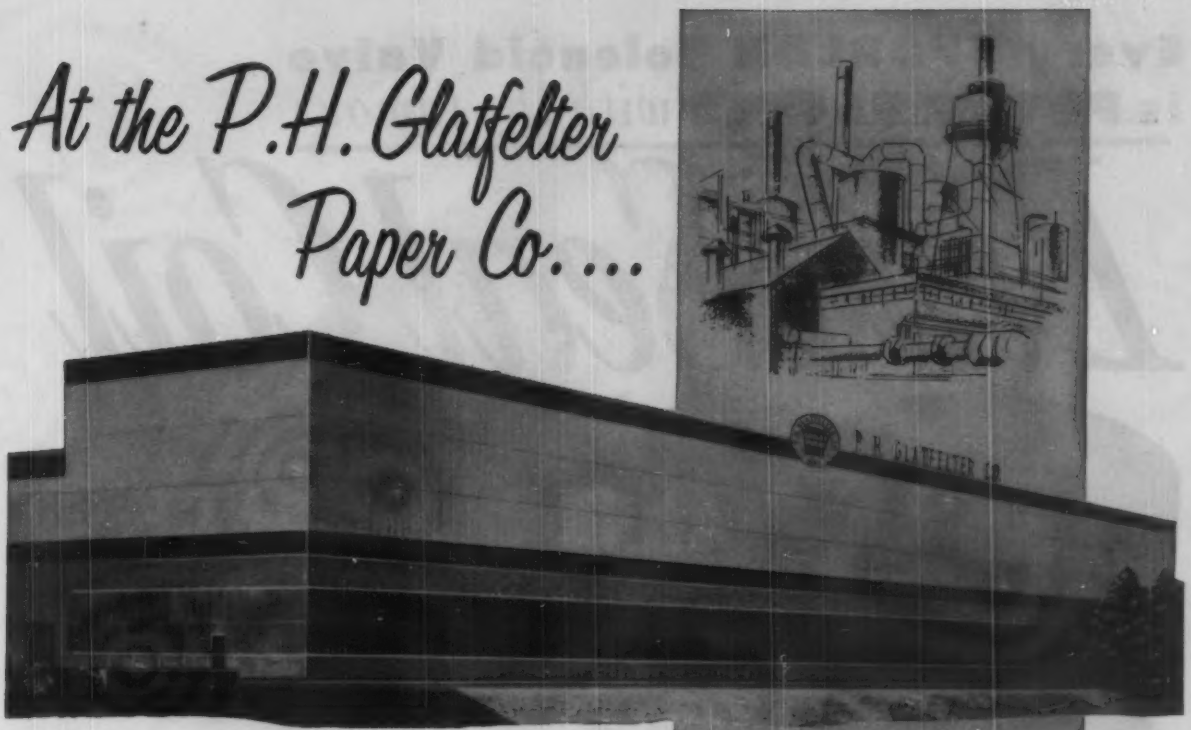
The No. 701 globe and No. 702 angle valves are for 150 pounds working steam pressure and 300 pounds water, oil, air or gas pressure. They are available in sizes from ⅛" through 3".

You can buy these composition disc valves from your O-B distributor. Ask him about the complete line of bronze O-B globe, angle, check and gate valves.

OHIO BRASS COMPANY • MANSFIELD, OHIO

4848-V

At the P.H. Glatfelter Paper Co....



AN AIR of MODERN DESIGN with dorex® Air Purification Equipment

The P.H. Glatfelter Company's new paper mill in Spring Grove, Penna., is an excellent physical expression of a growing trend in industrial architectural planning—modern exterior beauty matched by modern interior function.

Here, seventy-eight modern, soundly engineered Dorex Air Purification Cells were used to purify outside air and protect electrical equipment against destructive atmospheric properties.

Dorex equipment is specified and installed by leading architects and engineers because of matchless efficiency and the substantial savings on original investment and operating costs it permits. With each installation Dorex assumes *complete* responsibility for economical, efficient operation. Choose Dorex . . . you'll find that prompt, experienced personal service is an important Connor product.

CONNOR... for Constant Comfort Conditions

Write for "Air Conservation Engineering"... the authoritative text on air purification.

CONNOR ENGINEERING CORPORATION

82 SHELTER ROCK ROAD • DANBURY • CONNECTICUT

CONNOR ENGINEERING CORPORATION dorex® air recovery

Every SPORLAN Solenoid Valve is POWER PACKED *with the famous*

Blue Seal Coil

...to give you

PEAK PERFORMANCE
on Every Installation

No matter what the refrigerant, or job size...whether it's a water, or hot gas application...there's a Sporlan Solenoid Valve with the Famous Blue Seal Coil, that gives you that extra protection against burn outs, insulation and moisture failures, plus the time tested Sporlan design that makes Peak Performance a reality every time you install one!

So...get the best, every time...buy Sporlan Peak Performance Solenoid Valves for your very next job. They're Power Packed with the Famous Blue Seal Coil!

Include Sporlan Catch-Alls, See•Alls, Thermostatic Expansion Valves and Distributors with your Solenoid Valve order...

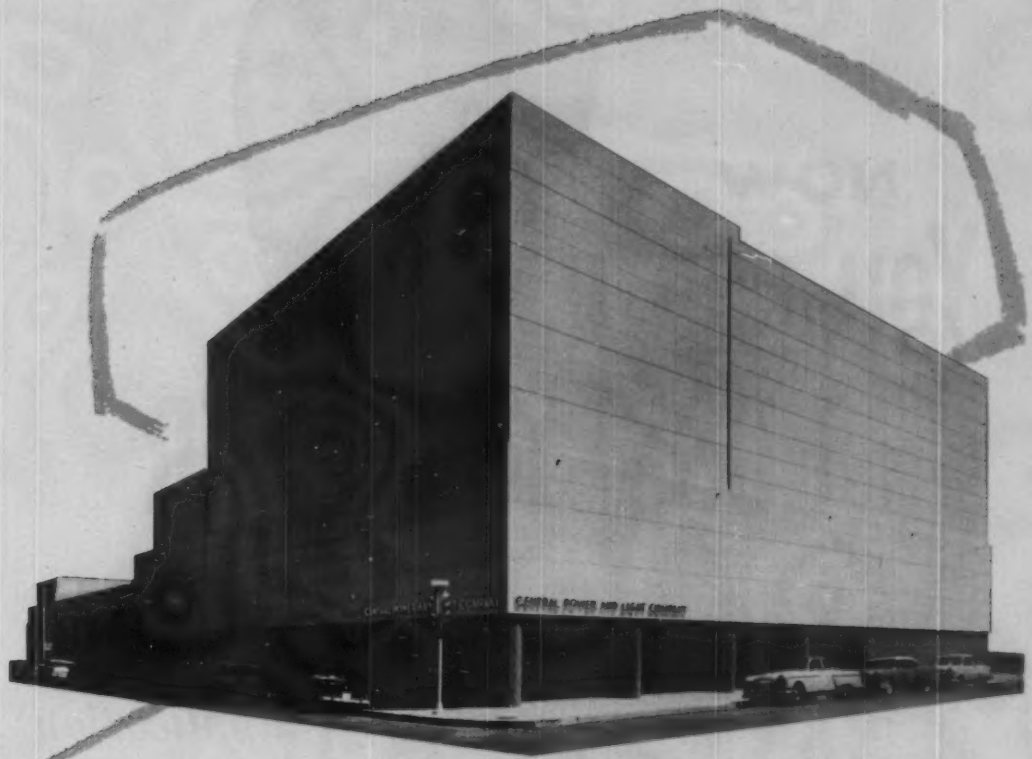
Get Peak Performance
Right Down the Line!

Your Sporlan Wholesaler has literature on all Sporlan Products...Be sure to ask him for Bulletin 30-10

SPORLAN VALVE COMPANY

7525 SUSSEX AVE. ST. LOUIS 17, MO.

EXPORT DEPT. 85 BROAD STREET, NEW YORK 4, N. Y.



WINDOWLESS BUILDING

RELIES ON THERMAL FOR AIR CONDITIONING and VENTILATION

Eight big, central plant and multizone type Thermal Engineering air conditioning units supply year-around all electric heating, cooling and ventilation for Central Power and Light Company's* remodeled and enlarged five-story building in Corpus Christi, Texas. The building is completely windowless except for street level display panels.

For air conditioning and ventilating equipment that you can rely on for efficiency, long life and economical operation, see your Thermal Engineering agent. The Thermal line includes central plant air conditioners; multizone air conditioners; sprayed coil units; heating and ventilating units; cooling and heating coils and air-cooled condensers.

*Robert L. Vogler, Architect
Vincent A. Foote, Mechanical Designer
Texas General Air Conditioning Co., Mechanical Contractors

Manufacturers' Agents . . .
territories open in certain areas . . . write us.

Quality Products Since 1945

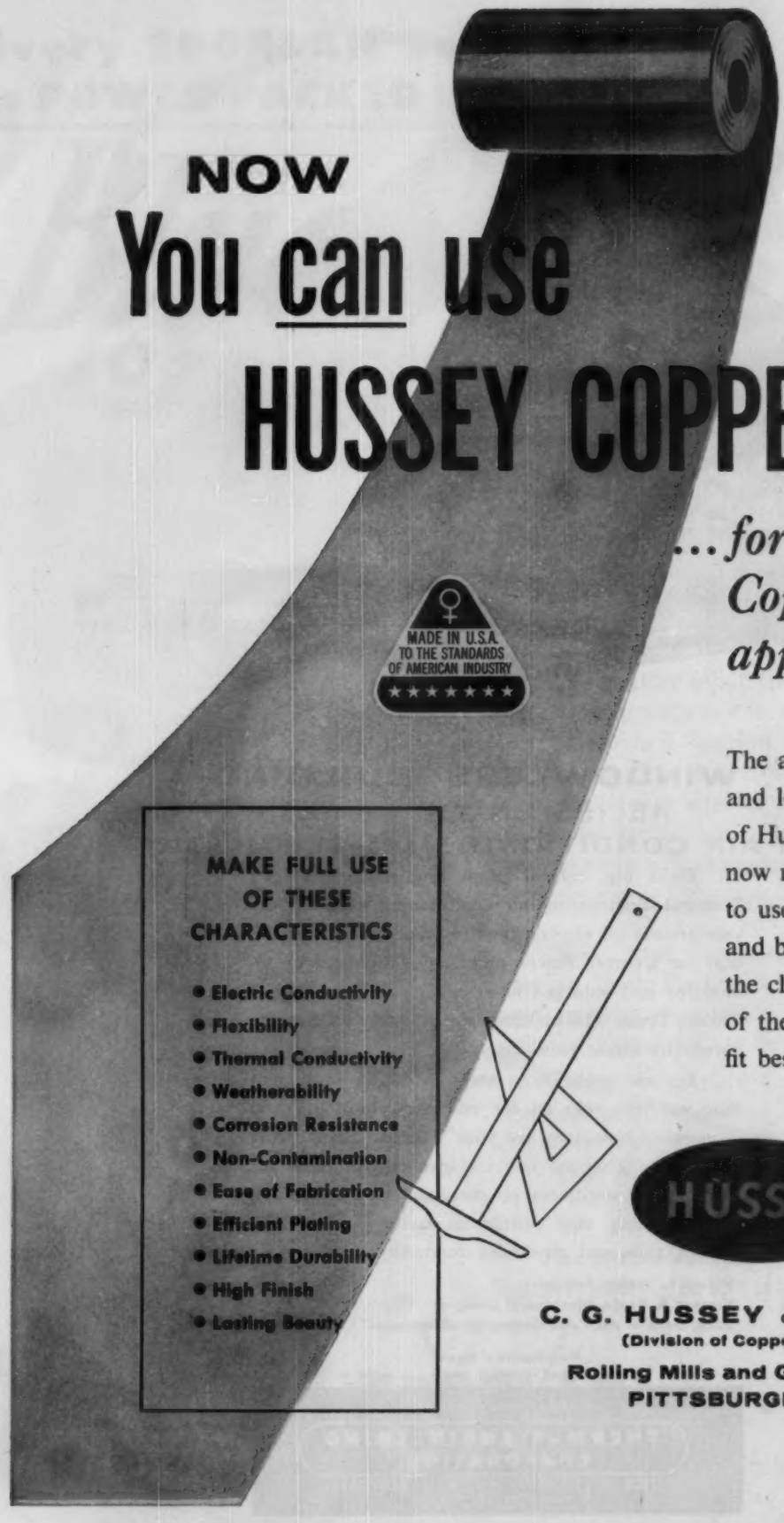
THERMAL ENGINEERING CORPORATION

2605 W. DALLAS • P. O. BOX 13254
HOUSTON 19, TEXAS

NOW

You can use HUSSEY COPPER

...for every Copper application



MADE IN U.S.A. TO THE STANDARDS OF AMERICAN INDUSTRY

MAKE FULL USE OF THESE CHARACTERISTICS

- Electric Conductivity
- Flexibility
- Thermal Conductivity
- Weatherability
- Corrosion Resistance
- Non-Contamination
- Ease of Fabrication
- Efficient Plating
- Lifetime Durability
- High Finish
- Lasting Beauty

The abundance and low cost of Hussey Copper now makes it possible to use Hussey copper and brass *everywhere* the characteristics of these metals fit best.

HUSSEY

C. G. HUSSEY & COMPANY
(Division of Copper Range Co.)
Rolling Mills and General Offices
PITTSBURGH 19, PA.

seals tight

without valve damage

How you cut costs with the new

TUBE-TURN LIGHT WEIGHT TAPER FACE FLANGES

The new TUBE-TURN* 125 lb. light weight, forged steel, taper face welding neck flanges (patent pending) can cut costs three ways:

1. You eliminate the hazard of breaking cast iron and semi-steel valves, fittings and equipment such as pumps and compressors, caused by overstressing the bolts to get a tight seal when regular ASA steel flanges are used.
2. You avoid the necessity of using more expensive 250 lb. valves with 300 lb. companion flanges.
3. The new flanges cost less, weigh less and take less storage space than the 150 lb. flanges they replace.

Maximum service pressures are the same as for Class 125 cast iron flanges in ASA B16.1, namely: 125 psi (gage) saturated steam; 175 psi (gage) liquid and gas (WOG) at 150°F.

Here is another example of the cost-saving advantages you realize when you specify TUBE-TURN products and buy them from your nearby Tube Turns' Distributor.

TUBE TURNS

A DIVISION OF NATIONAL CYLINDER GAS COMPANY

LOUISVILLE 1, KENTUCKY

TUBE-TURN

*"TUBE-TURN" and "tt" Reg. U.S. Pat. Off.

For more details, turn the page

The trademarks "TUBE-TURN" and "tt" are applicable only to the quality products of Tube Turns.

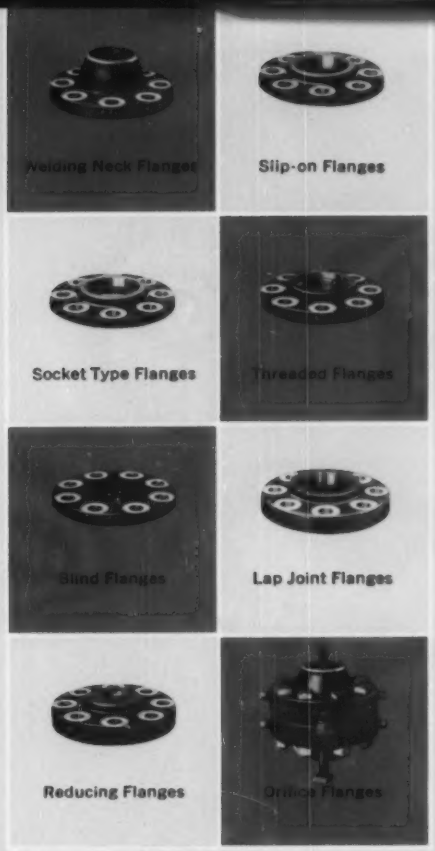
How TUBE-TURN® Taper Face Flanges give you a tighter seal without overstressing

TUBE-TURN taper face forged steel welding neck flanges conform to the 150 lb. American Standard with respect to flange diameter and drilling, but both the flange ring and tapered hub are thinned to make them compatible in strength and stiffness to Class 125 American Standard cast iron flanges with which they are mated.

In addition, the flange face has a 1½° convex taper which concentrates gasket contact pressure near the bore, reducing the required sealing force. As the bolts are tightened—but long before the bolt moment becomes excessive—the flexible steel flange is deflected toward the cast iron flange to the extent that contact is established over the entire gasket face.

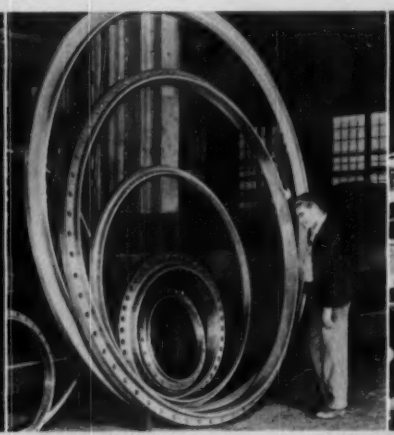
Thus, these features combine two important advantages: (1) A lower sealing force associated with minimum width ring gaskets, located at the bore; and (2) assurance against over-tightening which is characteristic of full face gaskets.

*"TUBE-TURN" and "tt" Reg. U. S. Pat. Off.



There is a complete line of TUBE-TURN Flanges.

Using TUBE-TURN Taper Face Flange on gas distribution line.



TUBE-TURN large diameter ASA Type and pressure vessel flanges.

Your nearby Tube Turns' Distributor provides a complete line of TUBE-TURN Flanges. This one source for all your needs in welding fittings and flanges (more than 12,000 items) enables you to put all your requirements on one order . . . to cut red tape and save purchasing time.

MAIL FOR WALL CHART—New flange matching chart simplifies checking and procurement. Enables quick selection of correct TUBE-TURN flanges for use with semi-steel lubricated plug valves.

TUBE TURNS
224 East Broadway, Louisville 1, Kentucky

Please send free Flange Matching Chart.

Company Name _____

Company Address _____

Your Name _____

Position _____

City _____ *Zone* ____ *State* _____

TUBE TURNS

A DIVISION OF NATIONAL CYLINDER GAS COMPANY
LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Detroit • Atlanta • New Orleans • Houston • Midland • Dallas • Tulsa • Kansas City • Denver • Los Angeles • San Francisco • Seattle. **IN CANADA:** Tube Turns of Canada Ltd., Ridgetown, Ontario • Toronto, Ontario • Edmonton, Alberta • Montreal, Quebec • Vancouver, British Columbia.

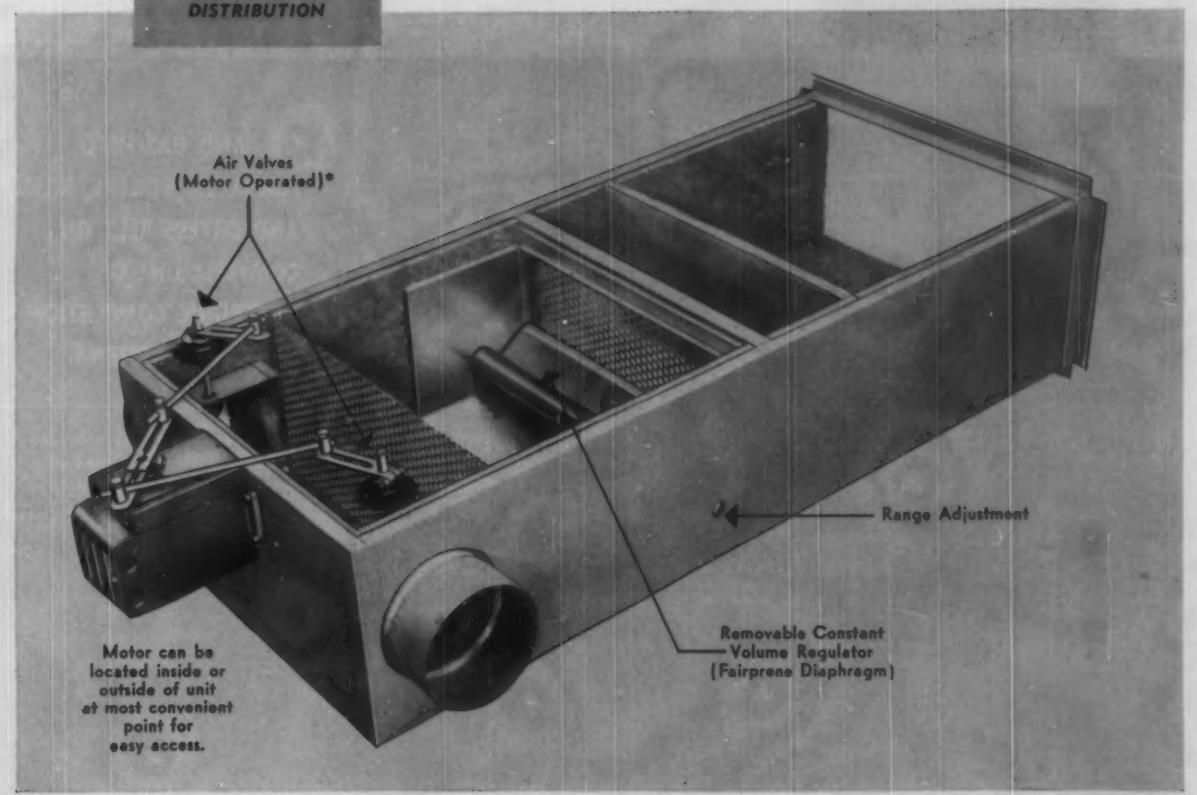
THE MARK OF QUALITY

BARBER COLMAN

Uni-Flo

ENGINEERED AIR DISTRIBUTION

New Self-Contained Constant Volume Control Simplifies Stabilization of High Velocity Systems


Air Valves (Motor Operated)*
Range Adjustment
Removable Constant Volume Regulator (Fairprene Diaphragm)
Motor can be located inside or outside of unit at most convenient point for easy access.

The new Uni-Flo double duct control mixes hot and cold air and reduces it to conventional velocity at minimum noise levels. It is available in octopus, open end, and integral diffuser types.

The unit features an extremely simple and effective self-operated, constant volume regulating valve. No power source or motor operator is required for volume regulation. The valve maintains constant CFM delivery from the box within ± 5% for hot and cold inlet air pressure differences as high as 5:1. A single spring-loaded manual adjustment lets you dial the CFM required.

The hot and cold inlet control valves can be either electrically or pneumatically operated, with the single motor mounted inside or outside the box. The air mixture is held uniform within 1° for each 10° F difference between hot and cold supply air.

On any high velocity double duct installation, this new unit greatly simplifies stabilization and assures continuous, dependable, automatic control. For complete information, dimensional and performance data, write today or call your local Barber-Colman office.

*. . . one source of responsibility when you specify your Uni-Flo double duct control with a Barber-Colman motor.

BARBER-COLMAN COMPANY

Dept. F, 1101 Rock Street, Rockford, Illinois

THE MARK OF QUALITY

BARBER COLMAN

Wheelco Instruments

a look under the cover shows why –

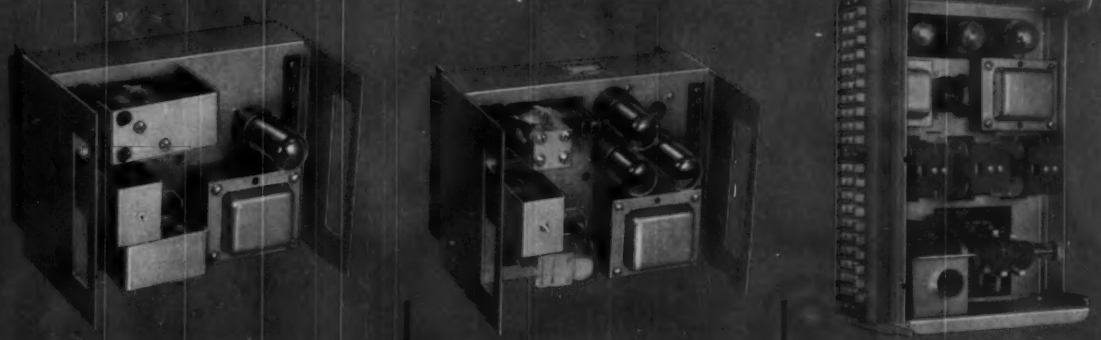
Wheelco FLAME-OTROLS

give better flame-failure protection

OIL- AND GAS-FIRED FURNACES, BOILERS, KILNS, AND DRYERS RELY ON COMPLETE LINE OF ELECTRONIC COMBUSTION SAFEGUARD SYSTEMS

Arrows indicate Wheelco lead-sulphide Flame-eye used on industrial-type combination oil-gas burners.

Wheelco Flame-otrol Plug-in Chassis



Model 1470 (manual-starting)
CONDUCTIVITY RECTIFICATION "CR" SYSTEM

. . . takes advantage of the unique features of a flame being able to conduct a small amount of electrical current with flow of electrons in direction of flame being greater than "up-stream."

Model 1570
INFRA-RED "IR" SYSTEM

Uses lead-sulphide photoconductive cell predominantly sensitive to infra-red energy as a flame pickup. It operates in conjunction with a "flame-only" type current when a flame is present and ignores constant bright background effect.

AUTOMATIC OPERATION

Two basic models (1474 and 1574) use same sensing elements as models listed above. Sequence timing for oil- or gas-fired burner or boiler operation includes: purging, warm-up proving, pilot-proving, low-fire stabilization, ignition-timing, and post-purging.

There's no need to "stretch" in order to make a combustion safeguard system fit your exact needs. From Wheelco's complete line you can select *exactly* the right Flame-otrol required by your installation — manual, semi-automatic, or fully automatic.

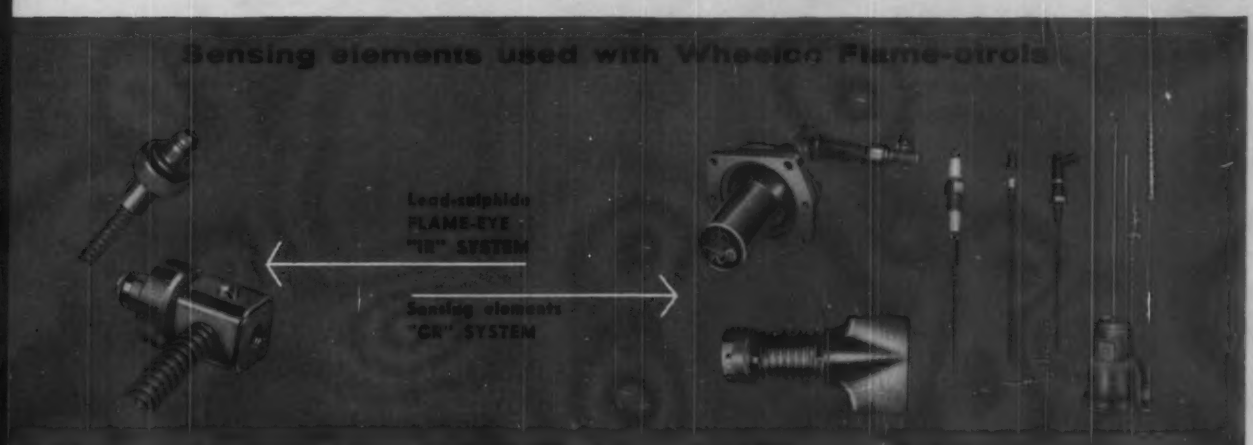
Whatever type of installation meets your requirements best, you'll be assured of getting a unit that's dependable in operation and simple to maintain. First, and foremost, there's the famous Wheelco plug-in design that conveniently enables the entire chassis to be removed for adjustment, examination, and repair.

In addition, convenient checking strips permit checking circuits and voltage with simple and readily available instruments. Standard electronic tubes are used on all Flame-otrol models, simplifying parts inventory and eliminating a possible replacement problem.

Because all Flame-otrol components are housed in a rugged, industrial-type steel cabinet, the unit operates satisfactorily in all types of plant locations. The gasketed, dust-tight, swing-out cover keeps out foreign matter that could impair operating efficiency.

Wheelco Control centers, designed with removable sections to meet changing requirements, are available to house complete combustion safeguard systems. Here, too, significant savings on installation costs and time are assured in a custom-engineered installation.

The quickest way to be sure of having a complete combustion safeguard system designed for your specific needs is to call your nearby Wheelco field engineer and let him analyze your requirements. This "no obligation" survey takes into consideration both economic and technical factors and results in a down-to-earth recommendation that insures you'll get the best possible buy for each dollar invested.



BARBER-COLMAN COMPANY

Dept. F, 1501 Rock Street, Rockford, Illinois, U. S. A.
BARBER-COLMAN of CANADA, Ltd., Dept. V, Toronto and Montreal, Canada

Industrial Instruments • Automatic Controls • Air Distribution Products • Aircraft Controls • Electrical Components • Small Motors • Overdoors and Operators Molded Products • Metal Cutting Tools • Machine Tools • Textile Machinery

Ford shifts

to coal for low-cost steam

Coal proves economical and easily available for steam generation at Ford's Louisville plant

Assembly Plant #2, Ford Division—Ford Motor Company, Louisville, Ky., was constructed in 1954. Because of the importance of steam for process work and heating, Ford's engineering department—working with the consulting firm of Albert Kahn Associated Architects and Engineers, of Detroit—conducted a fuel survey before the power house was designed. Object: to find an economical and efficient fuel.

Result: *coal* is used because of its *continuous* plentiful supply and advantageous price. Today this advanced coal-burning installation produces a reliable supply of low-cost steam. Only routine maintenance has been required and the cleanliness and general efficiency of this steam plant are considered among the outstanding features of its operation.

Facts you should know about coal

You'll find that bituminous coal is not only the lowest-cost fuel in most industrial areas, as in the case of Ford's Louisville plant, but up-to-date coal burning equipment can give you 15% to 50% more steam per dollar. Today's automatic equipment can pare labor costs and eliminate smoke problems. And vast coal reserves plus mechanized production methods mean a constantly plentiful supply of coal at stable prices.

Technical advisory service

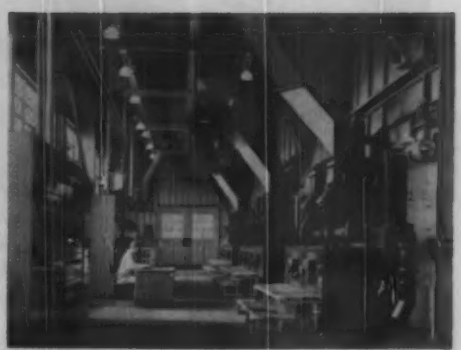
To help you with industrial fuel problems, the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to the address below. Or send for our case history booklet, complete with data sheets. You'll find it informative.

Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you in efficiency and fuel economy over the years.

BITUMINOUS COAL INSTITUTE

Dept. HP-06, Southern Building, Washington 5, D.C.



Firing aisle, shows Boiler #1 in right foreground. This is 60,000 lb/hr unit, using a two unit spreader stoker; Boilers #2 and #3 have capacity of 120,000 lb/hr and use four feeders. All three boilers are by Wickes Boiler Co., Type R, operating at 125 psi, 350 degrees F, fired by American Engineering "Perfect Spread" stokers.

Showing National Car Shaker being used to expedite emptying of cars. Dustless ash removal system in background.

Beaumont Birch Steam Vacuum System draws ashes through pipes to outside ash silo for removal. View is at basement level, below boiler room floor. Coal handling system also by Beaumont Birch Co.

Mechanical dust collectors are by Prat-Daniel Corp. Fly ash handling system removes ash from collectors and boiler passes.

8 reasons why
Now! Fibrocel made even better
through Johns-Manville Insulation Research
JOHNS-MANVILLE
JM
PRODUCTS
Apply Fibrocel to all hot and cold water pipes, dual service and steam lines from 35F to 300F in buildings like these:
Schools and Colleges

FIBROCEL® PIPE INSULATION

is the new standard for all commercial service

J-M Fibrocel has been the outstanding insulation in the low pressure field ever since its introduction three years ago. Now thanks to new findings by Johns-Manville's insulation research, it is even better in many ways. Today you get all these advantages in Fibrocel insulation:

Cleaner, sharper edges . . . Tight, snug-fitting edges provide better heat control, smoother appearance.

Smoother, harder surface . . . Normal abrasion and abuse in service cannot damage surface.

Firmer, stronger structure . . . Fibrocel resists compression and abuse. Gives back-up protection against puncture of jacket or vapor seal.

Heavier, smoother canvas . . . New canvas covering provides maximum protection and appearance.

plus these features always associated with Fibrocel:

No shrinkage . . . Joints stay tight . . . no unsightly gaps or costly repairs.

Easy to install . . . Fibrocel is light and easy to handle, is readily cut with a knife.

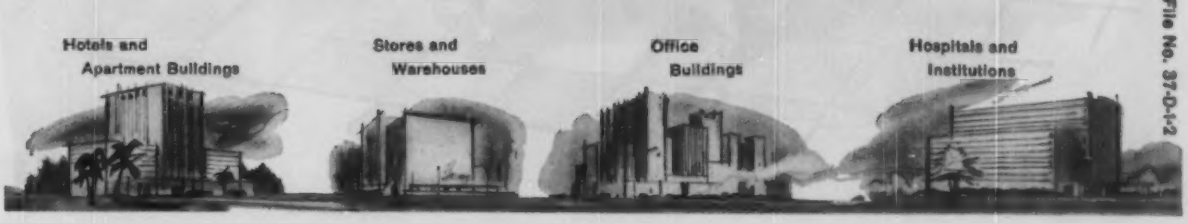
High thermal effectiveness . . . Tiny particles of silica are exploded and expanded to form a cellular structure of heat-trapping dead air spaces.

Permanent . . . Fibrocel is impervious to flame, rot, odor and vermin attack.

Write for free illustrated 8-page folder, IN-155A. It includes physical properties, insulating characteristics, sizes and thicknesses available. Address Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE INSULATIONS

FOR LASTING THERMAL EFFICIENCY



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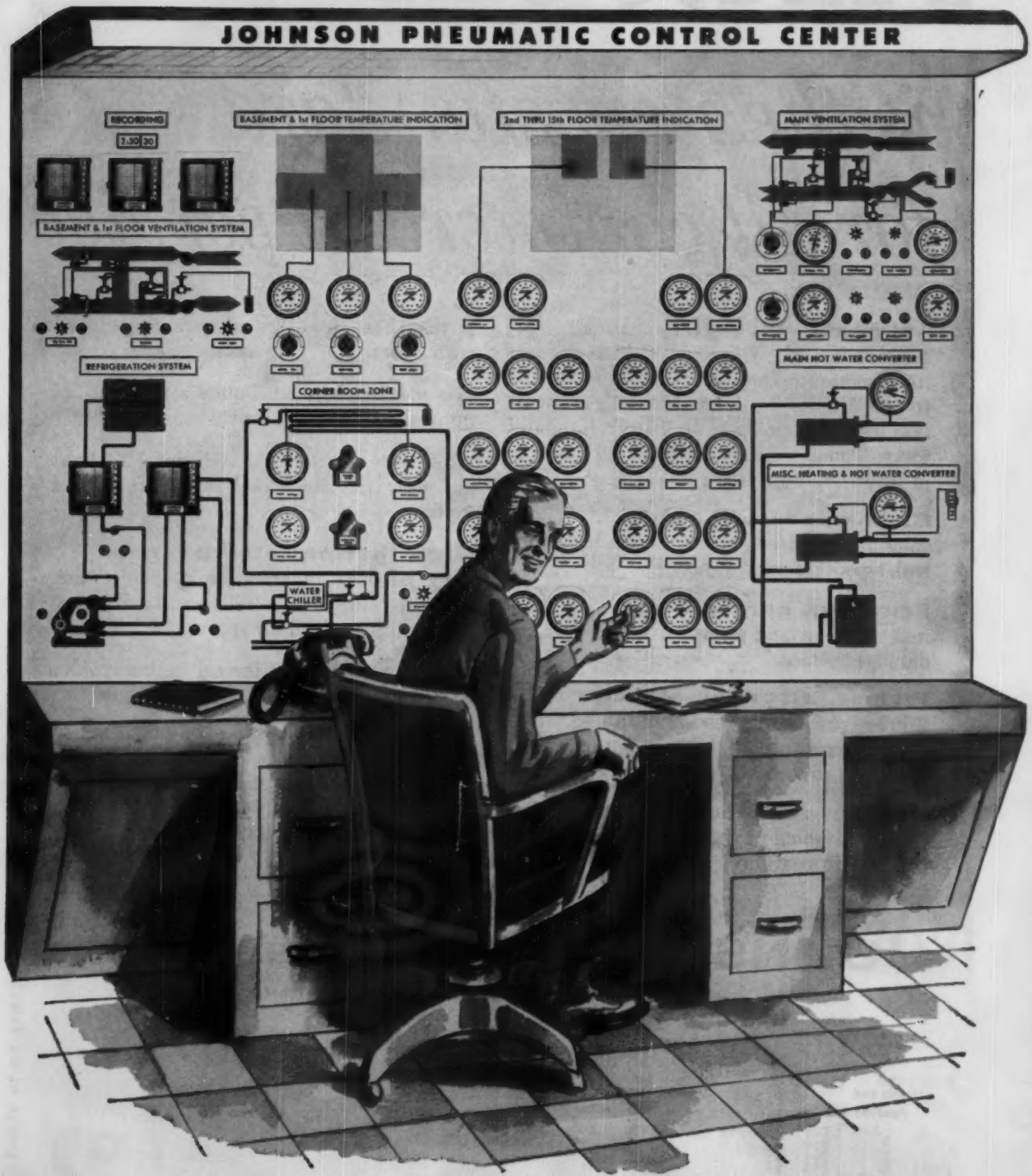
See How Much More



Your Clients Get with a

JOHNSON PNEUMATIC CONTROL CENTER

Whatever your reasons for including a control center in a client's building—manpower savings, convenience, greater comfort, special usage and occupancy problems, or longer equipment life—a a Johnson Pneumatic Control Center is the most practical way to get the desired results.

WIDE CHOICE OF FEATURES

Johnson Pneumatic Control Centers are designed with any combination of features required to provide efficient air conditioning operation. These include graphic representation of the air conditioning systems, remote indication of important temperatures and the operation of controlled devices, optional or continuous recording of key temperatures, remote temperature reset and many others.

EXCLUSIVE ADVANTAGES

The pneumatic control center not only does everything you and your clients expect of a control center, but it offers other important, *exclusive* benefits, as well.

EASIER TO OPERATE AND MAINTAIN

With pneumatics, you simplify the complex. You use fewer components. Being pneumatic, *the components of the control center itself are just as simple as the pneumatic controls used elsewhere in the building!* That means operating personnel can quickly and easily understand the operation of even the largest pneumatic control centers without extensive instruction and study. Pneumatics also simplifies maintenance.

ONE GLANCE TELLS ALL

Remote temperature indication is a basic part of all control centers. However, only the pneumatic control center gives *continuous* indication of key temperatures, such as outdoor air, hot and chilled water, fan discharge and dew point temperatures and temperatures in spaces subject to special usage or occupancy problems. With a separate pneumatic thermometer for each key point, the entire system can be checked with a single glance! Any need for adjustment shows up instantly without waiting for periodic checks.

Control pressure gages provide for continuous remote indication of the operation of the controllers and position of controlled devices. This exclusive pneumatic feature adds tremendously to ease and efficiency of operation.

NO SERVICE PROBLEMS

Likewise exclusive with pneumatic control centers is the vital assurance of nationwide service by full-time, factory-trained temperature control experts. There's no need to ask a client to take his chances on service, for Johnson Pneumatic Control Centers are backed by the oldest and largest service organization in the control industry.

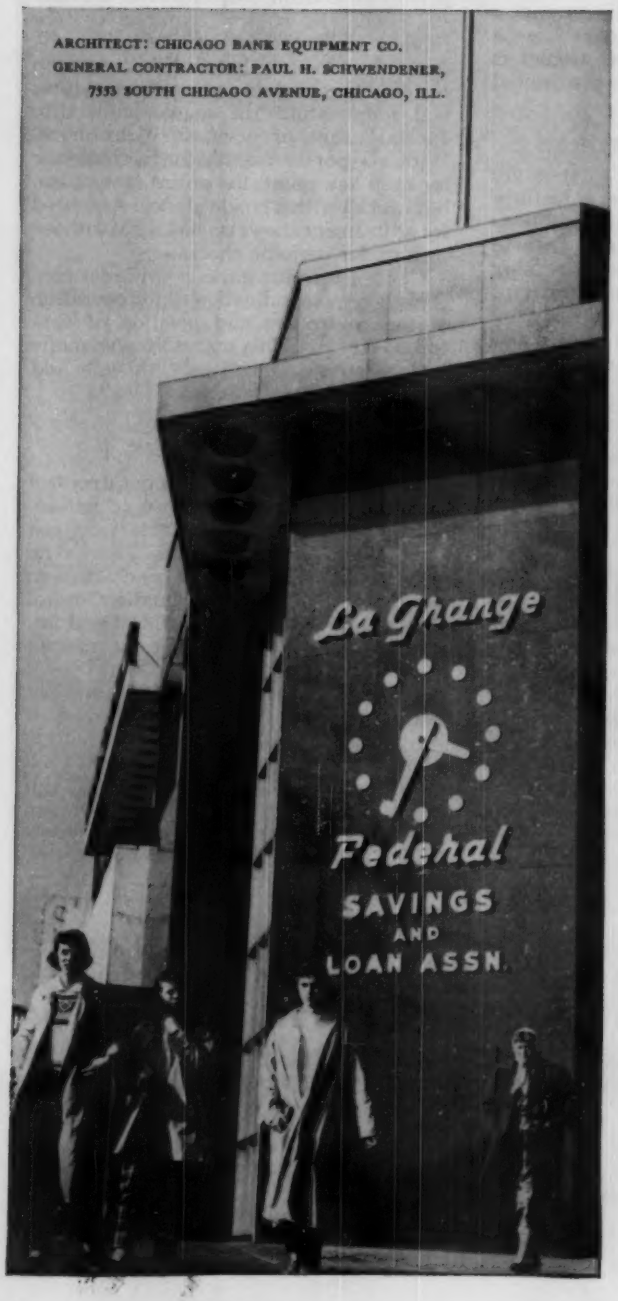
Johnson is presently making and installing Control Centers for buildings of all types and sizes. For more information about their advantages or recommendations on your specific problems, call a nearby Johnson engineer. Johnson Service Company, Milwaukee 1, Wisc. Direct Branch Offices in Principal Cities.

JOHNSON CONTROL

PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

...now we're cooling

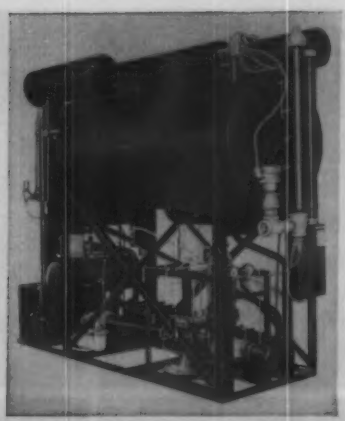


Specify Arkla-Servel Gas Air

With their new Arkla-Servel Gas Absorptive Cooler, the La Grange Federal Savings and Loan Association keeps customers cool in summer with the same compact system that keeps them warm in winter.

Before installing Gas, a complete study was made of available air conditioning systems. The Arkla-Servel unit—the only 25-ton absorptive cooler—was chosen because it is compact, easy to install, and costs are low for installation, operation and maintenance. No specially trained operating or maintenance personnel are required.

with GAS



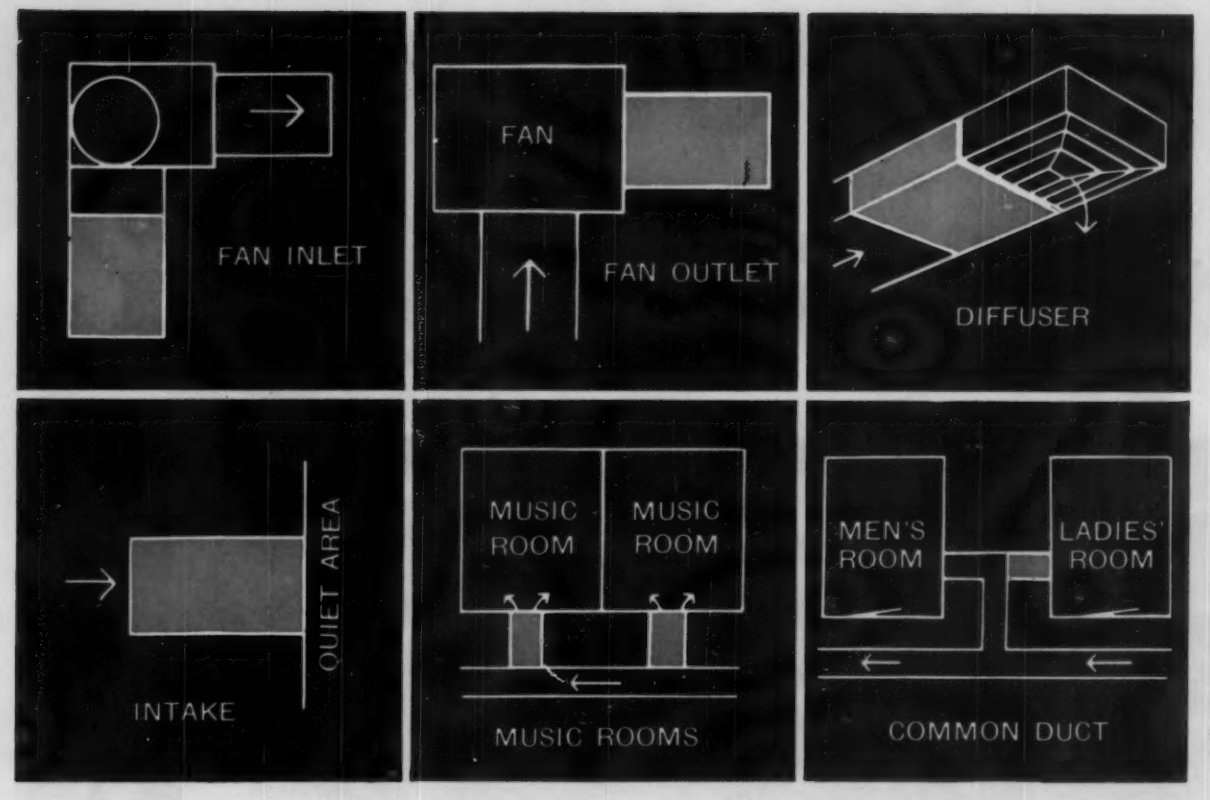
Conditioning and you specify years of trouble-free comfort

Only Gas gives these important advantages:

- high efficiency at all times—even during the light loads
- temperature control is constant
- modular adjustment of capacity (instant automatic adjustment to match actual cooling requirements)
- dependability of fuel service at all times

Gas absorptive cooling can put your commercial and industrial clients' heating plant on a year around paying basis. It utilizes low pressure steam to cool water, has no moving parts to wear out, and provides quiet, economical operation. What's more, it's vibration-free.

Take advantage of the consulting services provided by your Gas company. They have trained specialists who have been working with contractors and builders for years. They belong to your associations or affiliations and are familiar with your problems. Check the facts about Gas and you'll see modern Gas air conditioning out-performs all other fuels. *American Gas Association.*

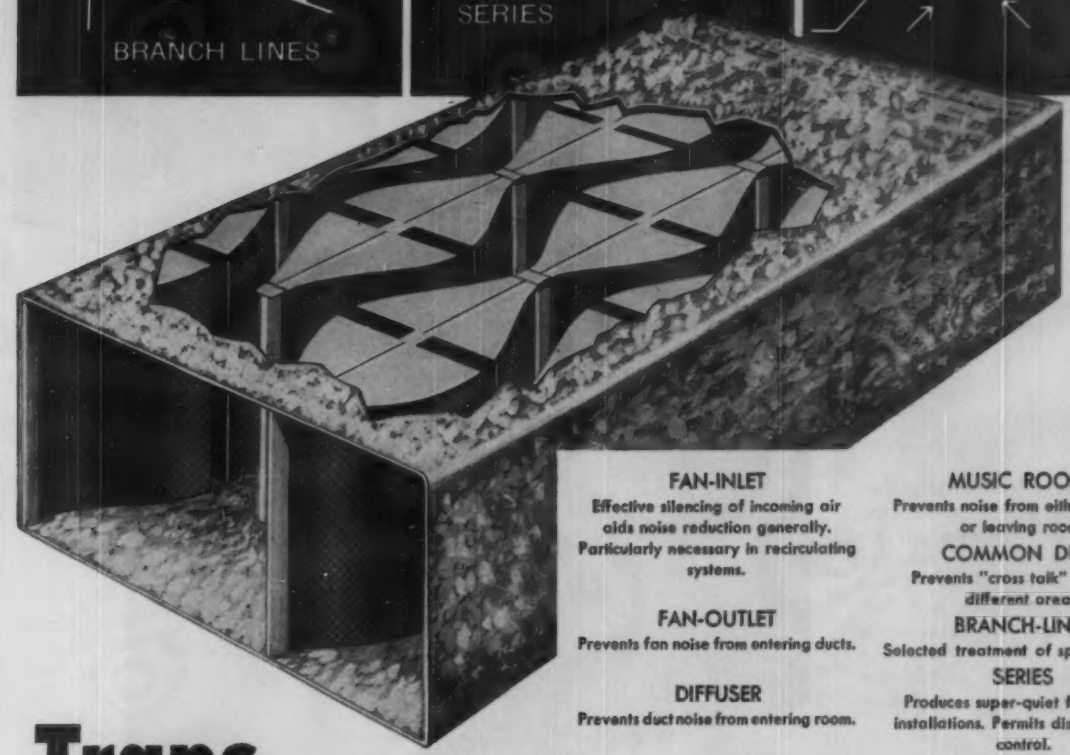


Every Building Needs Aircoustat® Sound

AIRCOUSTAT silences noises of all frequencies

Eliminate disturbance, distraction and irritation caused by noises escaping from one area to another through ductwork.

Install AIRCOUSTAT Sound Traps. AIRCOUSTAT eliminates guesswork, wasted space and unnecessary expense of duct lining. You can guarantee your client trouble-free performance. You can estimate with complete confidence the performance of particular applications. If AIRCOUSTAT fits geometrically, it fits acoustically.



Traps

FAN-INLET
Effective silencing of incoming air aids noise reduction generally. Particularly necessary in recirculating systems.

FAN-OUTLET
Prevents fan noise from entering ducts.

DIFFUSER
Prevents duct noise from entering room.

INTAKE
Prevents outside noise from entering quiet area.

MUSIC ROOMS
Prevents noise from either entering or leaving room.

COMMON DUCT
Prevents "cross talk" between different areas.

BRANCH-LINES
Selected treatment of special areas.

SERIES
Produces super-quiet for special installations. Permits discriminating control.

CEILING FANS
Prevents fan and exhaust noise from disturbing particular areas.

traveling from one area to another through ductwork

AIRCOUSTAT saves you space. Its greater effectiveness permits smaller-sized ducting. It eliminates bulky mufflers.

For more details, write to KOPPERS COMPANY, INC. Industrial Sound Control Dept., 6206 Scott Street, Baltimore 3, Md.

KOPPERS

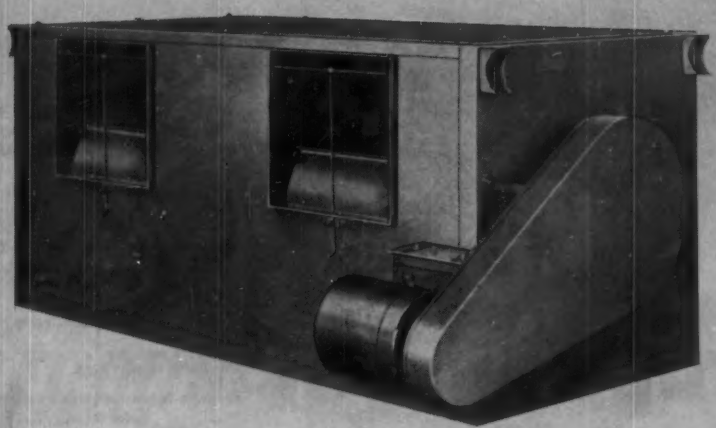
INDUSTRIAL SOUND CONTROL

Engineered Products Sold with *Service*

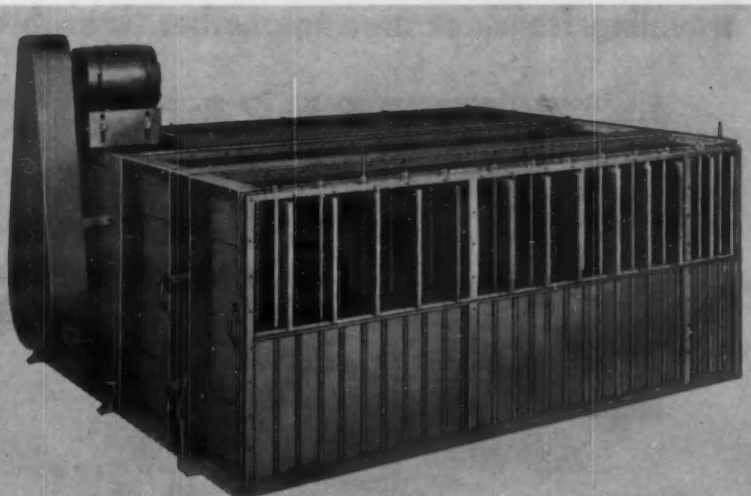
NOW! AMERICAN BLOWER

Heating and Ventilating Unit — Type V gives complete coverage of central-station heating and ventilating requirements. Steam or hot-water heating; large-volume, extra-quiet Sirocco Fans, for adequate heating and for ventilation. Ideal for offices, auditoriums, factory areas, gymnasiums, laboratories, schools and stores. Bulletin 8927.

Lineflow Ventilating Unit — Type L is a quiet, compact air handling unit for commercial and industrial uses. Designed for filtered air supply; fume and foul-air exhaust; air-conditioning zone distribution; and non-fouling kitchen and laboratory hood exhaust. Bulletin 8927.



Multi-Zone H & V Unit — Type VB provides individual zone control of temperature from a single central unit. Utilizes a "blow-thru" arrangement with individual zone dampers at the discharge end. Typical applications: schools, laboratories, offices and stores. Bulletin 8927.



DESIGNS NEW FLEXIBILITY INTO . . .

Heating and ventilating systems tailor-made with standard units

Sectional construction of basic components provides the required capacity, at savings in time, money and space!

Want the efficiency and operating economy of a "tailor-made" heating or ventilating system? Need the lower initial installed cost of pre-engineered, "ready-made" components? Build around one of these three new H & V Units by American Blower!

American Blower Heating and Ventilating Units offer broad capacity coverage, with eleven sizes to handle from 600 to 66,000 cfm. New flexible design and sectional construction give a bigger selection of efficient combinations and space-saving arrangements to fit your requirements.

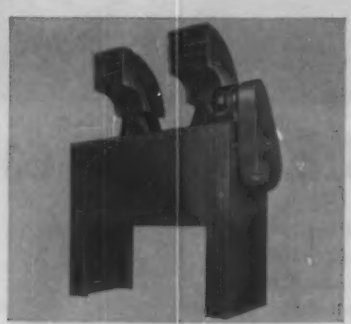
Units, coils and accessories assemble into a custom system at a packaged price. For example, there are eight unit arrangements based on fan rotation and discharge; four types of heating coils in a variety of arrangements with either top or bottom by-pass; and accessories such as filter boxes, face and by-pass dampers, damper-mixing boxes, and floor-base combinations.

Every American Blower H & V component is precision-made for fast mounting and low-cost installation. Units are easy and economical to maintain and service because motors, drives and bearings are externally mounted, easily accessible. For full details, send for Bulletin 8927.

Remember: When you specify American Blower, you get equipment that's designed, engineered and manufactured to work together . . . *plus* one-source responsibility for its performance. Branch offices in 73 cities offer local product help or nationwide sales-service coordination. American-Standard,* American Blower Division, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

Venturafin® Unit Heaters—for steam or hot water. Quiet; adjustable louvers. Horizontal or vertical. Bulletin 9017.

Cabinet Heaters—attractive, quiet. Models for all applications. Steam, hot water; to 1860 cfm. Bulletin 9617.



Industrial Unit Heaters—high-capacity, quiet. Universal cowls. Steam, hot water; 7 sizes, 4 arrangements. Bulletin 7727.

*American-Standard and Standard ® are trademarks of American Radiator & Standard Sanitary Corporation.

AMERICAN-Standard

AMERICAN BLOWER DIVISION

B.F.Goodrich

B. F. Goodrich does big job at world's biggest hotel

"When asked to equip 3200 rooms of the Chicago Conrad Hilton, the world's largest hotel, with individual air conditioning and heating units, we looked for a tubing that was simple to apply, required a minimum of labor to install, and gave us a perfect vapor seal from 40° F to 220° F at minimum cost," said Albert J. Schauer, design engineer for York Corporation, York, Pennsylvania.

"B. F. Goodrich Cell-Tite solved our problem perfectly. In fact, we are using 35,000 feet.

"B. F. Goodrich Cell-Tite's primary advantage is its versatility. It's pliable, slips over any given configuration, any twists and turns with ease.

"Another major labor-saving technique is prefabrication: we prefabricated much of the pipe before installation, cut our labor time by 50%. Time-saving features like this keep us right on schedule. B. F. Goodrich Cell-Tite comes in practical 50-foot lengths, too. This saved about 15% over the cost of other types of insulators that come in shorter lengths.

"Since B. F. Goodrich Cell-Tite is made of thousands of tiny individual air cells, completely sealing the copper tubing from the air, there is no air leakage and no condensation. We regard it as the perfect seal."

Find out how you can cut costs, simplify installation on your next job. Write The B. F. Goodrich Company, 481 Derby Place, Shelton, Connecticut.

B.F.Goodrich
insulation tubing

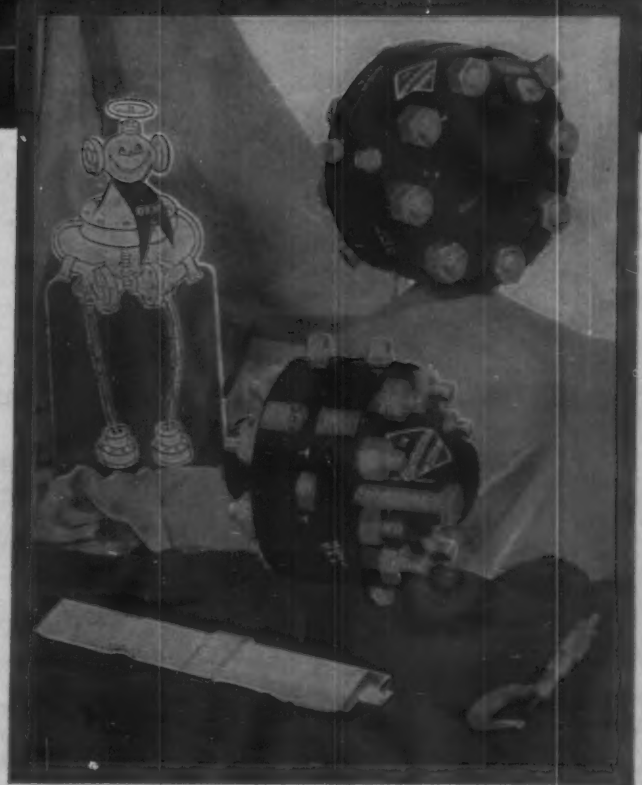
OTM

ELIMINATES FLANGE FAILURE!

Flange failure is expensive! Shut-down time and flow stoppage, to say nothing of damage costs and replacements, can eat up months of profits in no time at all!

But OTM's modern scientific methods — Reflectoscope, Magnaflux, tireless checking and rechecking, protective packaging — prevent all but the perfect flanges and fittings from reaching your job!

Exhaustive testing plus highly skilled machine work result in unequalled Blue Ribbon quality.



A-11-'57

FREEDOM FROM FLANGE AND FITTING FAILURE
GUARANTEED*

*by OTM exclusive guarantee and mill test report

OTM CORPORATION

P. O. Box 19296 Houston 24, Texas UN 2-6643
New York, N. Y. Odessa, Texas Dallas, Texas
Denver, Colorado New Orleans, Louisiana Los Angeles, California
Tulsa, Oklahoma

Available through authorized distributors only.

Buensod pioneered and introduced proper controls for Dual-Duct Air Conditioning. Inherently, such systems have unstable pressures—yet provide the greatest flexibility of control for the occupants. So the problem was to make . . .

a STABLE ual-duct syst n

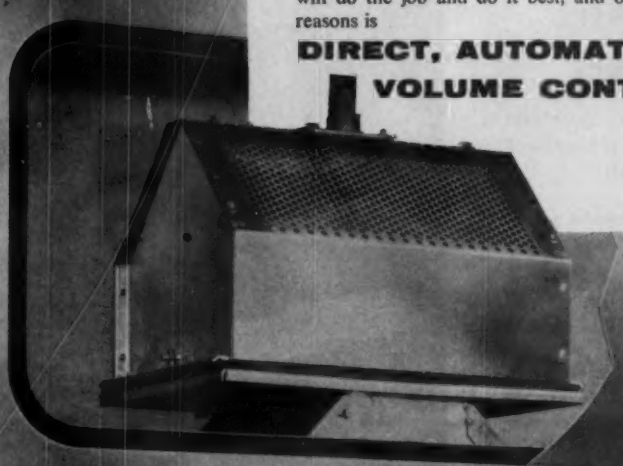
Buensod does it automatically and without a sensing instrument or complicated electronic device. This is DIRECT, AUTOMATIC VOLUME CONTROL. No matter what the variance in static pressures, a constant quantity of air is maintained in each unit. This makes it *impossible to unbalance any zone in the system.*

And it's so simple. A screw setting of spring tension at the time of installation and the unit need never be touched again. If after installation, a change of air volume in a particular zone is desired, it can be made quickly by adjusting one nut. When desired, volume adjustment can be pre-set at the factory by calibrated flow meters, eliminating the need for field adjustment. This, in effect, balances the entire system without necessity of a field check and re-balancing.

Compressed air from a local thermostat controls the mixing valve. No linkage. No pivot points. The valve has been designed for direct, straight-line movement.

Whether you're working on a new building or a renovation, Buensod Dual-Duct air mixing units will do the job and do it best, and one of the reasons is

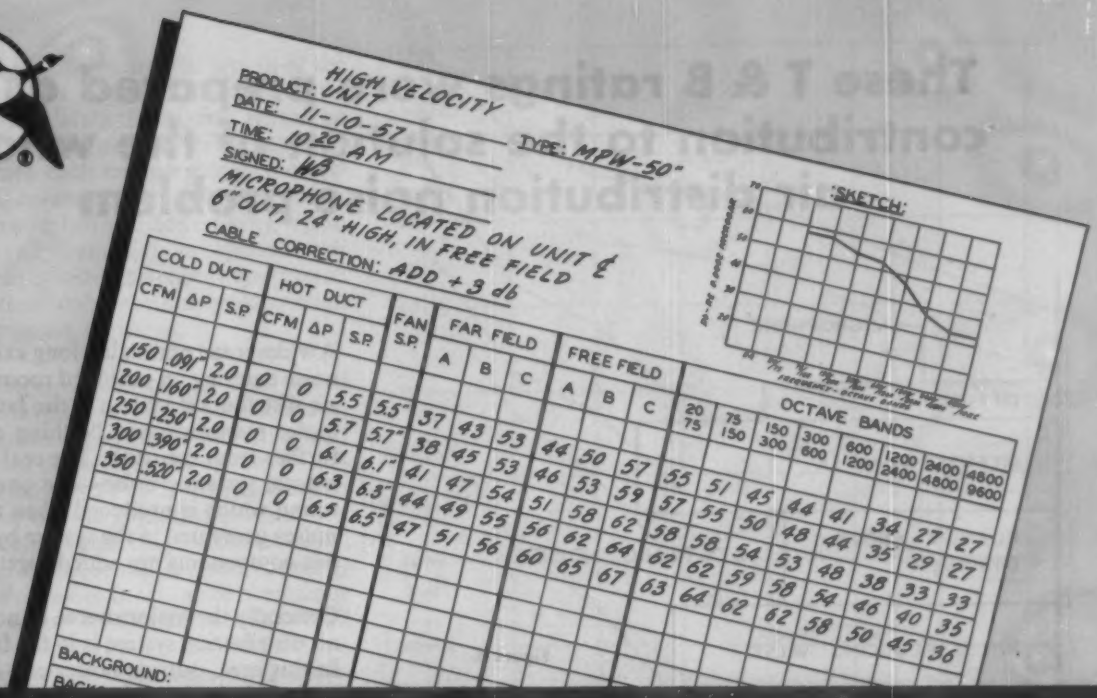
DIRECT, AUTOMATIC VOLUME CONTROL



For further information and complete specifications, see your local Buensod representative or contact us.

BUENSOD-STACEY, Inc.

BUENSOD-STACEY INCORPORATED



HIGH VELOCITY

PRODUCT: UNIT

DATE: 11-10-57

TIME: 10:20 AM

SIGNED: WB

TYPE: MPW-50"

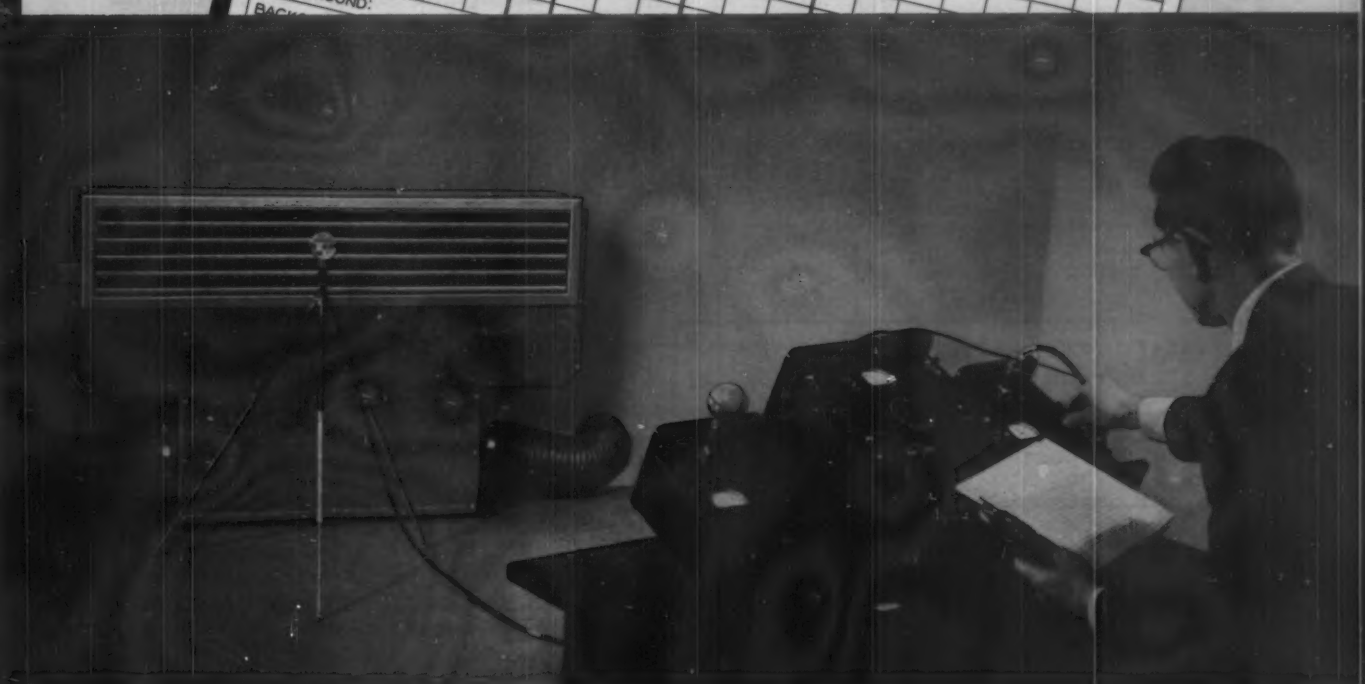
MICROPHONE LOCATED ON UNIT & 6" OUT, 24" HIGH, IN FREE FIELD

CABLE CORRECTION: ADD +3 db

SKETCH:

COLD DUCT CFM	COLD DUCT ΔP	COLD DUCT S.P.	HOT DUCT CFM	HOT DUCT ΔP	HOT DUCT S.P.	FAN S.P.	FAR FIELD A	FAR FIELD B	FAR FIELD C	FREE FIELD A	FREE FIELD B	FREE FIELD C	OCTAVE BANDS 20 75	75 150	150 300	300 600	600 1200	1200 2400	2400 4800	4800 9600
150	.091"	2.0	0	0	5.5	5.5"	37	43	53	44	50	57	55	51	45	44	41	34	27	27
200	160"	2.0	0	0	5.7	5.7"	38	45	53	46	53	59	57	55	50	48	44	35	29	27
250	250"	2.0	0	0	6.1	6.1"	41	47	54	51	58	62	58	58	54	53	48	38	33	33
300	390"	2.0	0	0	6.3	6.3"	44	49	55	56	62	64	62	62	59	58	54	46	40	35
350	520"	2.0	0	0	6.5	6.5"	47	51	56	60	65	67	63	64	62	62	58	50	45	36

BACKGROUND:



Now available from TUTTLE & BAILEY...

the first sound power ratings based on octave band analysis for air distribution devices

Sound power levels by octave bands have been scientifically established by Tuttle & Bailey for their air distribution devices. These ratings, the first in the history of this segment of the industry, were worked out by Tuttle & Bailey engineers in their own sound laboratories. They conform to the theory of sound evaluation published in the 1957 ASHAE Guide.

These T & B ratings were prepared as a contribution to the solution of the whole air distribution noise problem

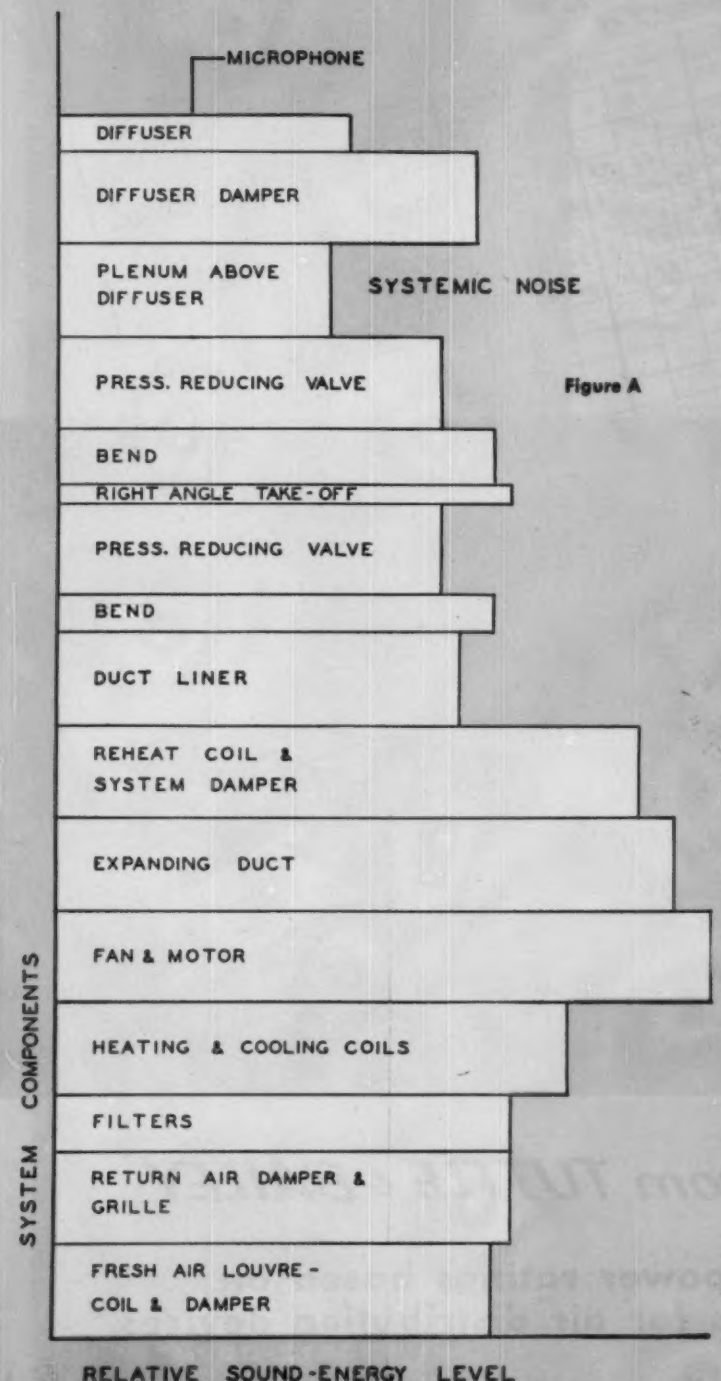


Figure A

A widespread notion has long existed that noise entering an occupied room from an air distribution system is the fault of the outlet manufacturer. Nothing could be further from the truth. The real problem is total systemic noise—the one audible sound which is produced when all of the noises generated in the system by its various components are added together.

Generally the major source of noise in an air distribution system is in the fan room. In this area, outside noises can enter the system through fresh-air intake louvers; and such equipment as refrigeration compressors, condensate pumps, return and exhaust fans, fan motors and most importantly the supply fan itself can add noise to the air being discharged into the duct system.

Other factors that influence the noise control problem are: heating or cooling coils, duct transformations, duct liners, duct work construction, bends, dampers, take-off connections, and the acoustical qualities of the occupied room in terms of room volume and surface absorption.

The noise problem in low- or high-pressure systems differs only in magnitude. Effects on the noise level output produced by each component, with changes in static pressure and air velocity, will vary in magnitude for every air distribution system, but the basic problem will always remain the same.

The total noise generated by all components can be reduced by the use of Tuttle & Bailey sound attenuation units located at the point of air distribution terminals in a high-pressure system.

What happens to sound energy as it leaves the fan and travels by air paths along a duct system is illustrated in Fig. A. The height of the bar represents fre-

quency distribution and the length of the bar represents intensity. The lengths of the blocks indicate the relative growth or decay of sound energy levels as the sound field passes each component in the system. The columns, therefore, increase or decrease in height depending upon whether all frequency components or equivalent broad-band energy are present or whether only certain predominant frequencies are registered.

The relative sound power and sound pressure levels will vary with frequency, and different components will either add or subtract noise from the system in certain frequencies (Fig. B). Frequency in cycles per second is plotted horizontally with a scale of decibels plotted vertically. Each curve delineates the sound-energy distribution as a function of frequency for each major component. In the overall noise produced by an air distribution system there are certain sound frequencies which interfere with speech communication. High noise intensity in the speech interference range (600-4800 cycles per second) can produce occupant discomfort. The final system design curve should be less in the speech interference range than the curve showing the selected room criterion.

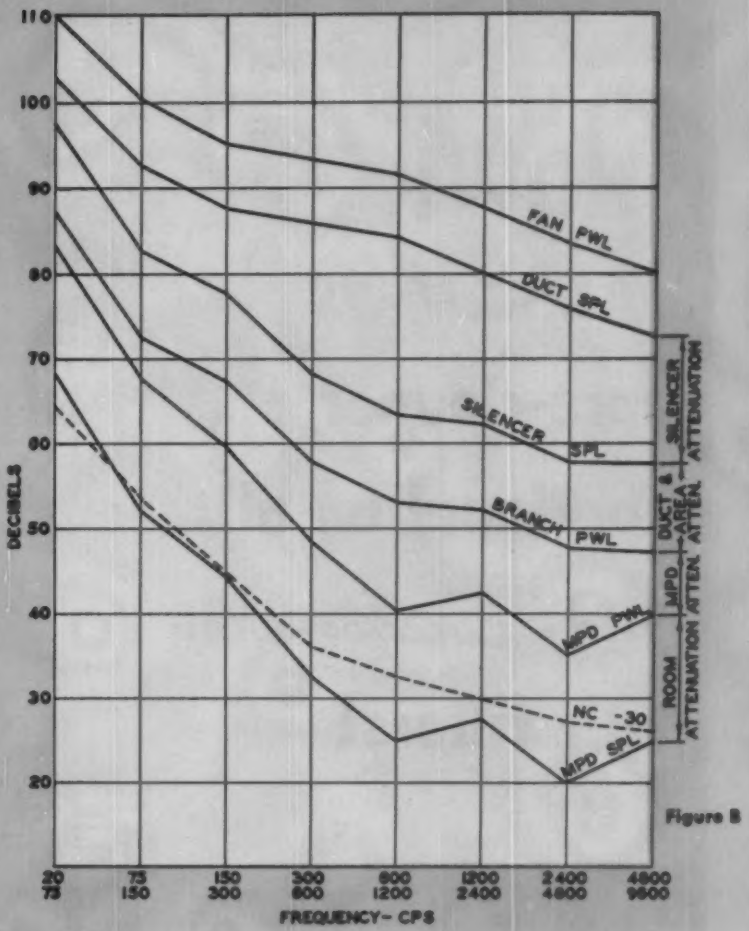


Figure B

For further information on the sound level ratings of Tuttle & Bailey equipment or for help in solving a specific air distribution problem, address: Engineering Department, Tuttle & Bailey, New Britain, Connecticut.

TUTTLE & BAILEY

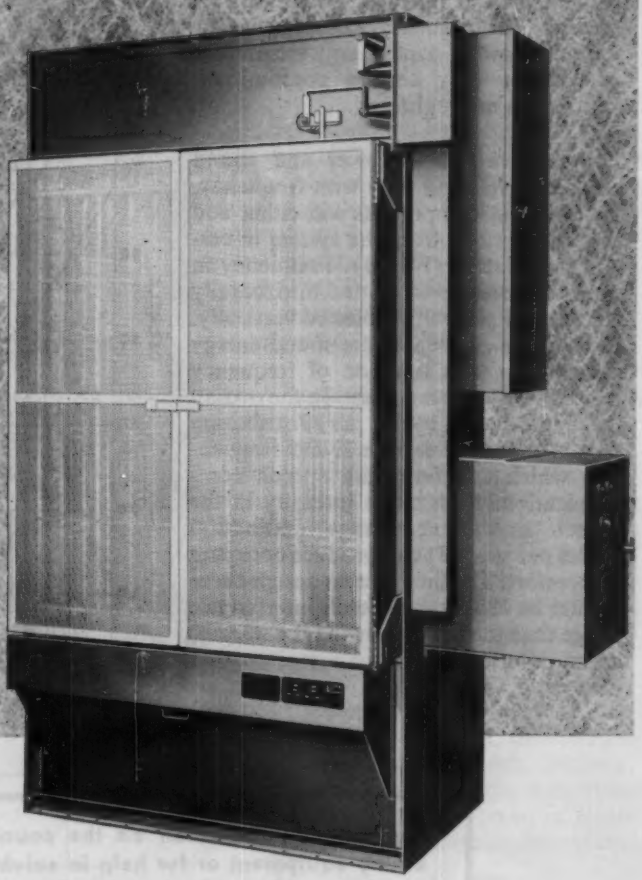
division of Allied Thermal Corp. New Britain, Connecticut

On the West Coast: TUTTLE & BAILEY PACIFIC, INC., City of Industry, California

A complete line of air distribution equipment and accessories for low- and high-pressure systems.

NOW!

AMER-*glas* pre-cleaner optional on all AAF *Electro*-MATIC air filters!



AAF "MIRACLE" MATERIAL reduces dirt load on precipitator

AAF's super-efficient electrostatic precipitator—Electro-MATIC—is now available with a built-in pre-cleaner (optional in place of standard perforated baffle). Made of AMER-glas—AAF's miracle glass fibre filtering material—this new pre-cleaner will substantially reduce dirt load on the self-cleaning Electro-MATIC.

Simple replacement of AMER-glas pads restores pre-cleaner to maximum efficiency. Ask your local American Air Filter representative for complete information on Electro-MATIC's optional AMER-glas pre-cleaner, or write us direct.

AAF American Air Filter
COMPANY, INC.
373 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal, P. Q.

BETTER AIR IS OUR BUSINESS

Only Halstead & Mitchell offers a cooling tower with a 20-YEAR GUARANTEE

ON THE WETTED DECK
AGAINST FAILURE
DUE TO ROTTING
OR FUNGUS ATTACK

Here's why this is important: Fungus growth on cooling tower wood fill very often can accumulate to the extent that it actually obstructs air flow through the tower. This reduces tower capacity and affects performance of the refrigeration or air conditioning equipment involved. In severe cases, the wood will rot and cause tower failure.

Treated Deckings—For positive protection against such harmful effects, Halstead & Mitchell subjects the wood deck material used in all H&M cooling towers to a special, pressure creosote treatment. That's why *only* Halstead & Mitchell offers a 20-Year Guarantee on the wetted deck against failure due to rotting or attack by fungus. Original tower capacity is maintained, and that reliability is what cooling tower purchasers need.

Anti-Corrosion, Plastic Coatings—Halstead & Mitchell Cooling Towers have many other design features that increase tower life and keep maintenance costs to a minimum. For instance, the cooling tower casings are completely protected against corrosion by separate plastic coatings of Vinsynite, Vinyl Zinc Chromate, and chlorinated rubber, *after assembly*. Every edge, every corner, is sealed against rust.

Permanently Sealed Bearings—Another example, fan bearings are permanently lubricated and sealed. Damaging moisture is kept out. Maintenance and periodic greasing are eliminated.

H&M Cooling Towers are available in capacities of 2 thru 125 tons. Types include propeller fan, centrifugal fan and take-apart models. See your local wholesaler, or write for more information. Halstead & Mitchell, Bessemer Building, Pittsburgh 22, Pa.

HM
Halstead & Mitchell

COOLING TOWERS · WATER-COOLED CONDENSERS
AIR-COOLED CONDENSERS · FINNED COILS

In zero weather this warehouse was heated at a monthly cost of less than a penny per square foot

During last January's sub-zero weather, Dravo *Counterflo* heaters maintained a comfort-heat level of 68° in this 79,000 square foot warehouse—and at a fuel cost of only seven-tenths of a cent per square foot for the month.

Recently erected for C. A. Turner Inc., Rankin, Pa., the insulated industrial supply warehouse, with high roof areas and large access doors for truck and rail shipments, is heated by just three 500,000 Btu/hr and one 750,000 Btu/hr gas-fired heaters.

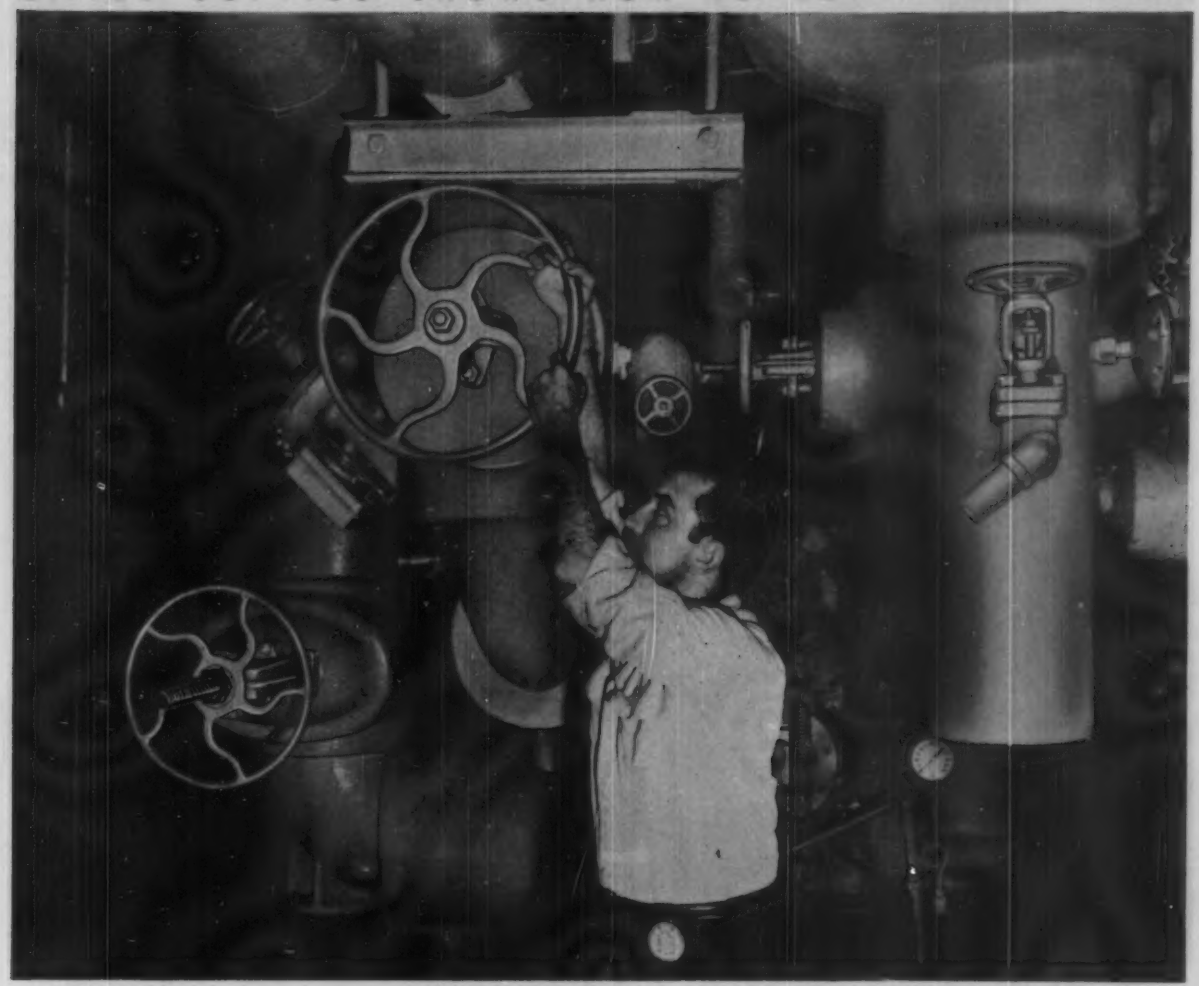
The Dravo "blanket-of-air" method of circulation is particularly effective in large, hard-to-heat areas. Based on high velocity discharge of warm air above the working zone and low velocity return at floor level, this system reduces heat-loss to the roof. Warm air is pulled down to the work area by the return of cool air to the heater. A Dravo heating engineer will be glad to explain the application of this money-saving principle to your particular heating problem.

Bulletin 564, describing the complete line of Dravo *Counterflo* heaters, is available. Write Dravo Corporation, Dravo Building, Pittsburgh 22, Pa.

DRAVO
CORPORATION

Blast furnace blowers • boiler and power plants • bridge sub-structures • cab conditioners • docks and unloaders • dredging • fabricated piping foundations • gantry and floating cranes • gas and oil pumping stations • locks and dams • ore and coal bridges • process equipment • pumphouses and intakes • river sand and gravel • sintering plants • slopes, shafts, tunnels • space heaters • steel grating • towboats, barges, river transportation

Cities Service shows how to cut valve costs



Crane globe valve in 14th year on steam turbine line

Cities Service Refining Corp. uses hundreds of valves at its Lake Charles, La., plant. Maintenance and replacement costs could be staggering, but for careful control of valve selection.

For example, the Crane 6-inch, 300-pound steel globe valve shown above was installed at the Lake Charles plant 14 years ago. Working at 250 psi., 600 deg. F., the valve is used in the steam line to a turbine-driven feed-water pump.

In spite of its operation 3 or 4 times a week, this sturdy Crane valve has continued tight in service and has required no repairs in 14 years!

Thrifty buyers want no better reward than the kind of cost-cutting, dependable service they get when Crane valves are installed.

That's why in the petroleum industry, as in all industries, you'll find more Crane valves used than any other make.

This is the valve used on installation above. CRANE 151XR, 300-pound cast steel globe valve for 850° F. maximum temp. Sizes: 2 in. to 8 in. For full details, see your Crane Representative, or write to address below.

CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

chosen to heat the building and entrances of the

WORLD'S LARGEST OUTDOOR SKATING RINK

The twenty-two industry-approved, performance-proved features of Airtherm Cabinet Unit Heaters made them first choice for this world famous project. These, combined with an Airtherm Centrifugal Fan Heating and Ventilating Unit and Propeller Fan Unit Heaters, will guarantee efficient, trouble-free heating performance through the years.

Note: The Centrifugal Unit heats the major portion of the building through perforations in the acoustical aluminum ceiling, automatically providing 100% outside air during the day and re-circulated air at night.

SEND FOR CABINET UNIT HEATER CATALOGUE #1402

Contains specifications on 8 models from 304 CFM to 1600 CFM, and 22,200 BTU to 124,800 BTU.

The Mark Steinberg Memorial Skating Rink Operated by the City of St. Louis provides 230' x 120' of ice—the largest artificial outdoor ice skating rink in the world. Adjoining building houses a kitchen, snack-bar, skate rental and change area, pro shop, storage, first-aid and office.

Architect: Frederick Dunn & Associated Architects
General Contractor: Robert Paulus Construction Co.
Consulting Engineers: Ferris & Homig
Mechanical Contractor: Shure-Richardson, Inc.

Convectors • Propeller Fan Unit Heaters • Direct Fired Space Heaters • Gas Fired Unit Heaters • Centrifugal Fan Unit Heaters
Cabinet Unit Heaters • Air Conditioning Units

AIRTHERM MANUFACTURING COMPANY, 702 S. SPRING, ST. LOUIS 10, MO.

Luxury MOTEL solves noise problem by changing to

B&G UNIVERSAL PUMPS

The seven-acre, landscaped patio of HiwayHouse includes a swimming pool, children's playground, golf putting area and a miniature railroad. Year 'round air conditioning is provided by a central circulated water system.

MECHANICAL CONTRACTOR:
Arizona York Refrigeration Co., Phoenix, Arizona

HIGHLIGHTS OF B&G UNIVERSAL PUMP DESIGN

● Non-overloading motor—constructed, selected and stamped for *extra quiet* operation ● Sleeve bearings, oil lubricated, in both pump and motor ● Motors ring-type mounted, suspended in rubber ● Spring-type quiet coupler ● Oversized special alloy steel shaft with integral collar which absorbs thrust ● Removable bearing frame—no need to break pipe connections or remove motor ● "Remite" Mechanical Seal, diamond hard, prevents water leakage ● Hydraulically balanced impeller

Reg. U.S. Pat. Off.

HiwayHouse, fabulous 250-room motor hotel at Phoenix, Arizona, was planned and built by Del E. Webb Construction Co. with the comfort and convenience of guests as the only consideration. Among its features is a circulated water heating and cooling system, which required corrective measures because of noise.

The mechanical contractor describes the cause and the remedy as follows:

"A conventional type of pump was originally used in the air conditioning system. When the system was turned on, a motor hum and water noise was transmitted through the units in the motel rooms. The room units with their copper coils and radiator fins acted as sounding boards, particularly at night when fans were off.

"To correct this problem we replaced the conventional pumps with Bell & Gossett Universal Pumps properly sized for the job. This completely eliminated transmission of noise and there is now 100% quiet operation in all rooms of the motel.

"In general, it has been our experience that B&G Universal Pumps for this type of operation are far superior to any other type of pump and we recommend them highly."

BELL & GOSSETT
COMPANY

Dept. FH-5, Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong Ltd., 1400 O'Connor Drive, Toronto 16, Ontario

STRIPLINE

Distinctive SLOT TYPE Diffusers

Look around . . . you'll see STRIPLINE by AGITAIR everywhere. And no wonder. STRIPLINE combines the best features of both slots and efficient air diffusers to provide equalized air flow throughout its entire length.

Slender, inconspicuous, practical and versatile . . . STRIPLINE slot diffusers can be located in walls, ceilings, coves, moulds, window reveals, stools . . . yes anywhere to suit interior design.

Designer:
Maria Bergson Associates

THERMOTANK — AGITAIR

high velocity units • punkah louvers
air diffusers • filters • exhausters

Sold exclusively by representatives for:

AIR DEVICES INC.

185 MADISON AVENUE, NEW YORK 16, N. Y.

Write for Complete Stripline Catalog

Type H Stripline shown in above installation

One North La Salle Building, Chicago. This 48-story office building is being completely air conditioned.

another "skyscraper" uses Allen-Bradley trouble free control

It's no "accident" that Allen-Bradley motor controls are selected for so many of the larger air conditioning installations . . . it's because of their *recognized* reputation for long, trouble free life.

The simple solenoid design—which *only* Allen-Bradley offers in *all* sizes up through Size 7—has only ONE moving part. There are no bearings to corrode and stick . . . no flexible jumpers to wear and break. Also, the double break, silver alloy contacts—standard *throughout* the Allen-Bradley line—never need service attention. You can install Allen-Bradley control . . . and forget it.

Be sure to specify Allen-Bradley . . . the *quality* motor control . . . for your air conditioning system. You will never regret this decision. Send for your copy of the latest A-B Catalog, today.

Consulting Engineers: Brooke & Chaporis.
Air Conditioning Contractors: Gallaher & Speck.
Electrical Contractors: Goldberg & O'Brien Electric Co.
Managing Agent: L. J. Sheridan and Co.

Above: The first of three 500-ton Trane units with its Allen-Bradley Bulletin 1277 reduced voltage autotransformer starter. Below: Open view of the Bulletin 1277. This starter has closed circuit transition, and meets power company requirements for acceleration without heavy current surges.

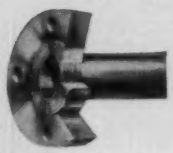
ALLEN-BRADLEY
QUALITY
MOTOR CONTROL

Allen-Bradley Co., 1335 S. First St., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

3 BIG REASONS WHY...

1. FLANGE WITHOUT WELDING

Faster than welding... *easier* than welding. A Speedline Insert Flange assures a leak-proof, *expanded* joint *every* time. Saves assembly time *and* costs!



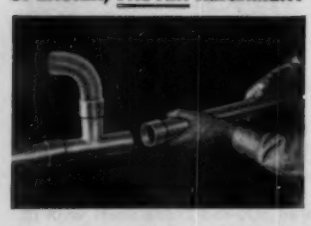
Cutaway view shows pipe expanded into Insert Flange

2. LEAKPROOF UNION JOINTS

Speedline Unions are *gasket seated* to prevent leakage ... bi-metallic for easy make-up and disassembly without galling or seizing. Available in two types: PE for expanding or PW for welding to Sch. 5 or 10 pipe and Speedline Fittings.

Type PW—For Welding

3. EASIER, FASTER ALIGNMENT



Speedline Aligning Connectors fit *over pipe ends* ... save time in aligning the most complex layout —permit preassembly *prior* to welding or brazing!

***PLUS* SPEEDLINE'S "EXTRA LENGTH" FEATURE**—There's an extra straight section on *every* end of *every* Speedline elbow, tee, reducer, bend and cross. This means extra clearance for welding and also facilitates joining with flanges or unions. Speedline Fittings, designed especially for use with Schedule 5 and 10 light wall stainless pipe, offer installation advantages and other cost savings not possible with conventional fittings. Write today for Speedline catalog or contact nearest Distributor.

810

Speedline STAINLESS STEEL FITTINGS

THE NEWEST THING IN PIPELINE ECONOMY

Manufactured by **HORACE T. POTTS COMPANY** • 576 E. Erie Avenue • Philadelphia 34, Pa.

THERE'S A *SPEEDLINE* Distributor IN YOUR AREA

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SERVICE STEEL DIVISION VAN PELT CORP.
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J. M. TULL METAL & SUPPLY COMPANY, INC.
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ALLOY METAL SALES LTD.
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RAILWAY & POWER ENGINEERING CORPORATION LTD.
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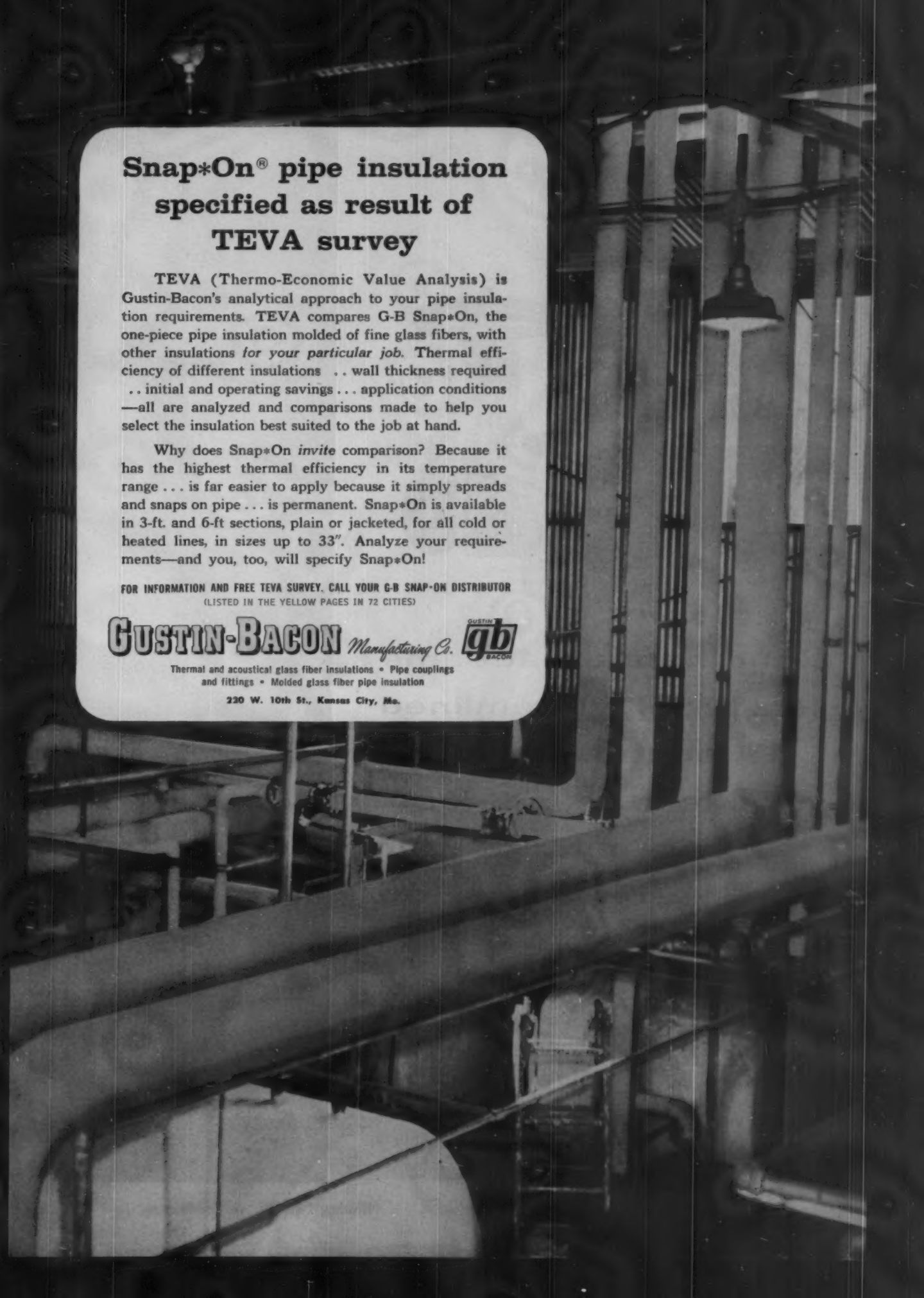

Snap*On® pipe insulation specified as result of TEVA survey

TEVA (Thermo-Economic Value Analysis) is Gustin-Bacon's analytical approach to your pipe insulation requirements. TEVA compares G-B Snap*On, the one-piece pipe insulation molded of fine glass fibers, with other insulations *for your particular job.* Thermal efficiency of different insulations . . wall thickness required . . initial and operating savings . . . application conditions —all are analyzed and comparisons made to help you select the insulation best suited to the job at hand.

Why does Snap*On *invite* comparison? Because it has the highest thermal efficiency in its temperature range . . . is far easier to apply because it simply spreads and snaps on pipe . . . is permanent. Snap*On is available in 3-ft. and 6-ft sections, plain or jacketed, for all cold or heated lines, in sizes up to 33". Analyze your requirements—and you, too, will specify Snap*On!

FOR INFORMATION AND FREE TEVA SURVEY, CALL YOUR G-B SNAP-ON DISTRIBUTOR
(LISTED IN THE YELLOW PAGES IN 72 CITIES)

GUSTIN-BACON *Manufacturing Co.* GUSTIN gb BACON

Thermal and acoustical glass fiber insulations • Pipe coupling and fittings • Molded glass fiber pipe insulation

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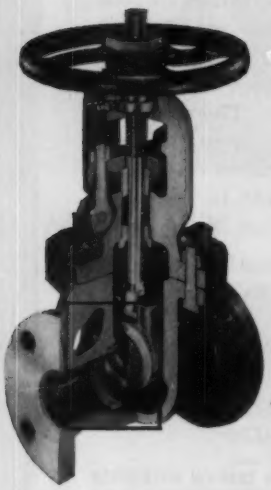
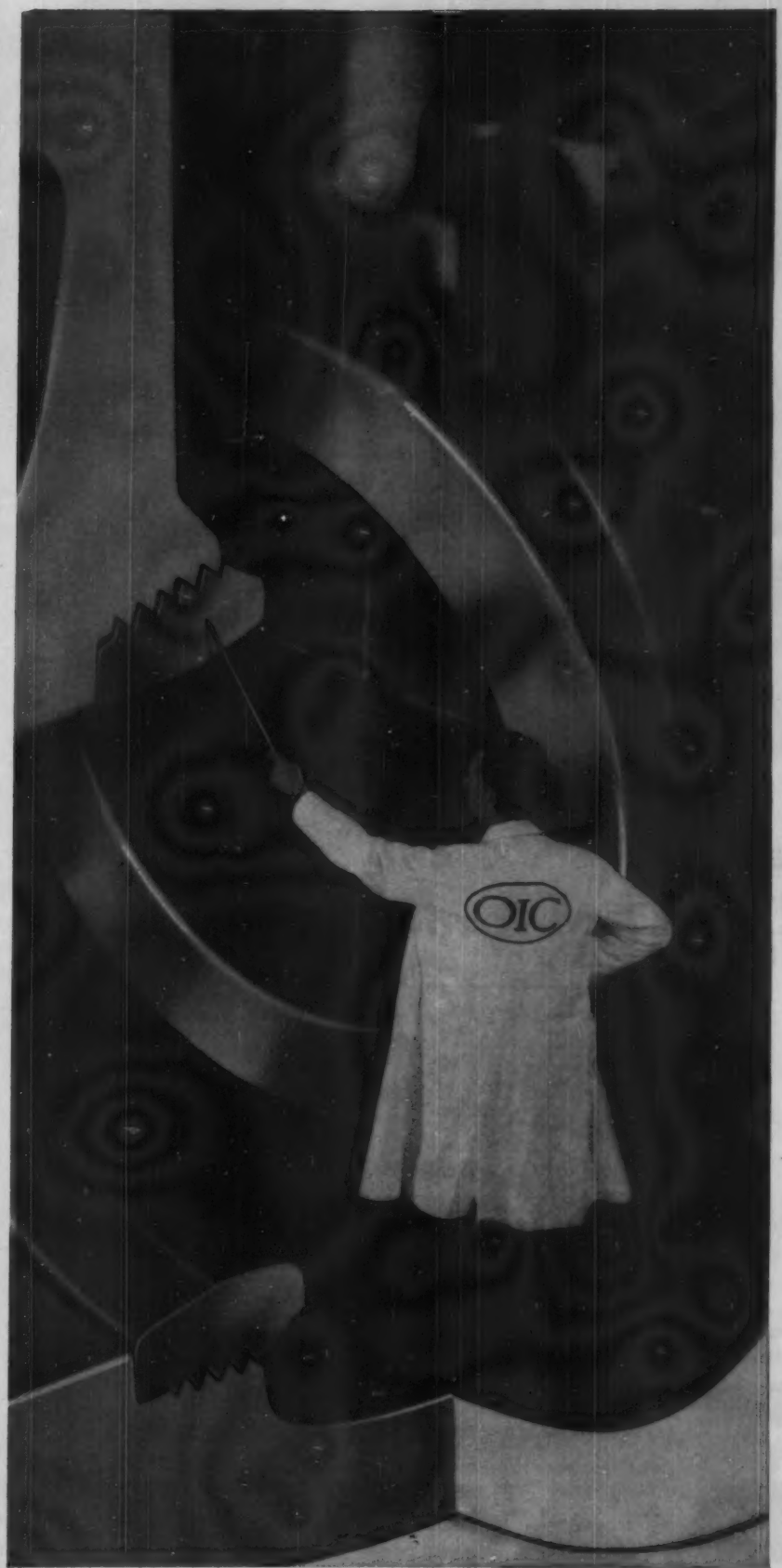


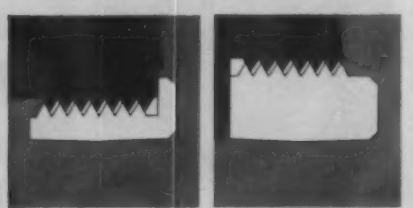
...and here's that same leakproof, streamlined seat ring– a steel valve feature, so good, we put it on our iron valves, too

OIC VALVES | BRONZE, IRON, FORGED AND CAST STEEL; LUBRICATED PLUG VALVES



See how this *end*-seated ring fits into the valve body, out of the flow. It streamlines the body port, eliminates excessive pressure drop across the valve.

Here's how these rings reduce your maintenance problems . . .



Old-style, shoulder-seated ring cross section

OIC *end*-seated ring cross section

Old-style *shoulder*-type rings interrupt flow, cause turbulence. Since rings are seated in *tension*, they loosen and leak.

These OIC streamlined rings are *end*-seated in *compression* against the body. They can't loosen, even in continuous operation, so they won't leak.

3 OIC iron valve features that add to your maintenance savings

Yokes in all sizes permit replacement of the yoke nut when the valve is wide open, without interrupting flow.

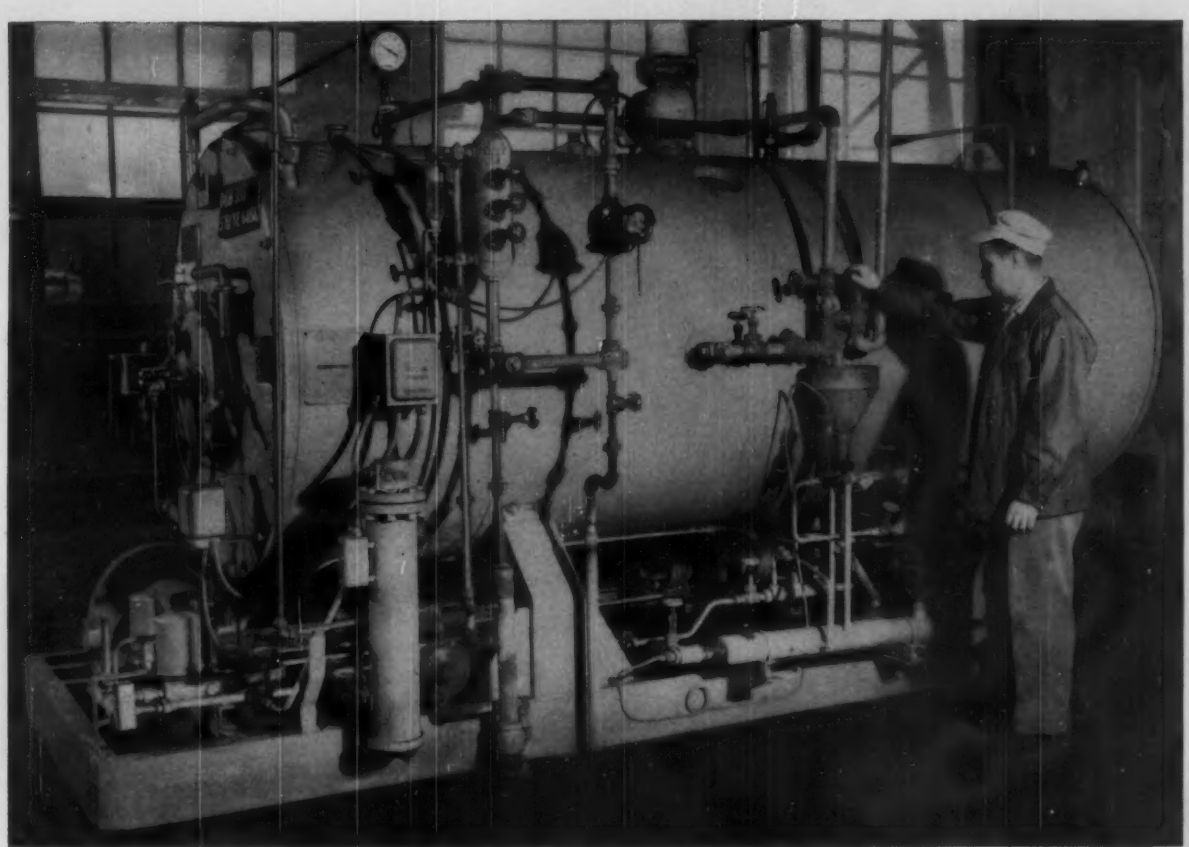
T-head stem-wedge connection prevents wedge from binding when closing the valve. Closing is easy, positive, least wearing to trim parts.

Threaded backseat bushing seals off upper bonnet of fully open valve. Makes repacking under pressure possible.

Choose for your service from 29 OIC iron valve numbers with 9 different trim and body metal variations. Order from your OIC Distributor or write for complete specification literature.

THE OHIO INJECTOR COMPANY

WADSWORTH, OHIO



125 HP AMESTEAM GENERATOR Installation at Delaware and Hudson RR Diesel Shops at Binghamton, N.Y.

D & H R R ESTIMATES $30,000 ANNUAL SAVINGS WITH FOUR AMESTEAM GENERATOR AUTOMATIC BOILERS

"... we estimate $10,500 annual savings ... more than 44 percent return on our investment ... with the 125 HP AMESTEAM GENERATOR installation at our Binghamton diesel shops alone ..."

And that's only *one* of four AMESTEAM GENERATOR installations mentioned in a letter to us from Mr. P. O. Ferris, Chief Engineer of the Delaware and Hudson Railroad. Mr. Ferris goes on to say ...

"At the present time we have installed these generators at the following locations, at the estimated total annual savings of $29,899 shown:

LOCATION	H. P.	Estimated Annual Savings	Percent Return On Investment
Rouses Point	125	$ 8,350.00	33.2
Whitehall	200	6,841.00	22.3
Mechanicville	80	4,208.00	19.7
Binghamton	125	10,500.00	44.2
ESTIMATED TOTAL ANNUAL SAVINGS		$29,899.00	

What more can we add to this factual testimonial of satisfaction from the Delaware and Hudson Railroad? Only this: we have on file similar reports from hundreds of satisfied users of AMESTEAM GENERATORS. Among leading railroads alone, we number 40 satisfied customers ... using 194 of our economical, dependable "package type" boilers.

This all adds up to *your* assurance of savings and satisfaction with AMESTEAM GENERATORS.

AMES IRON WORKS INC.
BOX D-68 OSWEGO, N.Y.

WHAT'S YOUR STEAM PROBLEM?

For high-quality automatic package boilers, 10 to 600 HP, write us today for the name of your AMESTEAM GENERATOR Representative and our latest catalog.

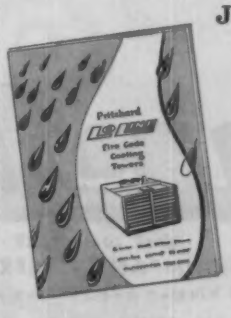
sleek... low... and fire-safe

A Pritchard LoLine Fire-Code cooling tower is not a tower at all. Webster defines a tower as "a building or structure typically higher than its diameter." But the LoLine is less than half as high as its longest dimension. Rather than protrude from your building or grounds like a monstrous growth, defying all attempts at camouflage, the Pritchard LoLine hugs its base, can be smoothly integrated with its surroundings.

Moreover, the Pritchard LoLine Fire-Code cooling tower is safe. A companion to the Pritchard LoLine wood-framed tower, it is designed specifically to meet standard metropolitan fire codes. All structural members are steel. Louvers, casing, water distribution system and fan deck are asbestos cement. There simply is no combustible material exposed to the risk of fire.

It's rugged, too. Corrosion-resistance of steel parts is assured by hot-dip galvanizing *after* fabrication, not before. Only heart-quality California Redwood is used for fill and drift eliminators. Long, trouble-free life is assured. And the tough, asbestos cement board exterior never needs painting. Maintenance is virtually eliminated.

If you would like more information about the 75-ton-and-up Pritchard LoLine Fire-Code cooling "tower," mail coupon for Bulletin 5.2.902. Or consult the Yellow Pages, under "Towers," for the name of your nearby representative.



J. F. PRITCHARD & CO. OF CALIFORNIA
Dept. 104, 4625 Roanoke Parkway, Kansas City 12, Mo.

- ☐ Send bulletin 5.2.902 on LoLine Fire-Code Towers
- ☐ Send bulletin 5.1.902 on LoLine Wood-Framed Towers
- ☐ Please have your representative contact me

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Firm.....

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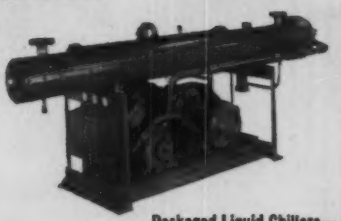
City..... Zone..... State.....

You can count on HIGHER PROFITS WITH Curtis AIR CONDITIONERS

Evaporative Condensers and Cooling Towers up to 100 tons
Air handling units to match.



Packaged Liquid Chillers—7½ to 100 tons—F-12 or F-22. With room console units to provide controlled cooling and heating without duct work.

HERE'S WHY...

MAXIMUM DEPENDABILITY

Each CURTIS unit is backed by 104 years of engineering and manufacturing experience... one of many reasons why CURTIS air conditioning equipment operates at maximum efficiency with a minimum of maintenance.

CUSTOMER SATISFACTION

The long operational life and minimum service requirements of CURTIS air conditioning, combined with peak performance, assures satisfied customers.

PRE-SOLD PROSPECTS

National advertising beamed at virtually every prospect category helps *pre-sell* Curtis equipment for you. CURTIS provides sales and promotional aids to make your selling job *easier*.

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All Curtis air conditioning equipment is *competitively* priced, with a very generous profit margin *for you!*

Packaged air conditioning units—3 through 50 tons.

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Condensing units up to 100 tons—F-12 or F-22.

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ZALLEA NON-EQUALIZING EXPANSION JOINTS . . .

Zallea Non-Equalizing Corrugated Expansion Joints offer a degree of protection that can't be equalled for absorbing movement of piping due to temperature changes. They protect interconnected equipment by absorbing movements in otherwise rigid piping systems. They are used in low pressure and vacuum lines . . . between stills, tanks, columns, condensers, pumps and similar equipment.

Standard Sizes: 3" to 72" dia.; Special sizes to 50 ft. dia. Pressures: Vacuum to 50 psig. Temperatures: to 1600°F.

Special Applications. With the addition of proper components, Zallea Non-Equalizing Expansion Joints can be used as:

Universal Expansion Joints to absorb movement in any direction . . . axially, laterally, angularly, or any combination of these.

Pressure Balanced Expansion Joints to absorb axial movement outside the unit and still carry pressure thrust.

Hinged and Gimbal Expansion Joints for piping systems that cannot be anchored in the conventional manner.

Get the complete story of Zallea Expansion Joints in our new 72-page manual. They are available for any pressure condition to 3600 psig. Write, on your company letterhead, for your copy of Catalog 56.

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News about

B.F.Goodrich Chemical *raw materials*

Sanford station of Florida Power & Light Company uses Geon conduit furnished by Hughes Supply of Daytona Beach. B.F.Goodrich Chemical Company supplies the Geon polyvinyl material only.

corrosion problem knocked out . . .

generating station gets conduit of Geon

YEARS from now pulling new cable through this conduit made from Geon polyvinyl materials will be just as easy as it is today. Unlike ordinary steel conduit, Geon conduit resists the corrosive effect of salt water, gases, chemicals and acid or alkaline soils. Internal and external surfaces stay smooth—like new.

Conduit or pipe made from Geon offers high tensile or impact strength. It stands up under pressure . . . is not subject to galvanic corrosion. It resists sunlight, fungi, bacteria, moisture, heat and cold. And its light weight makes installation especially easy.

Engineers are taking advantage of properties of pipe and conduit of Geon in a wide variety of applications. For information, write Dept. LW-3,B.F.Goodrich Chemical Company, 3135 Euclid Ave., Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ont.

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It's a wrench!
Fits "Genetron" cylinder valve stems and valve outlet caps—also fits stems of compressor service valves, soldering gas cylinders, etc.

Comfortable finger grips

¼" tool steel, smooth plated finish

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Here's a tool you've never seen before—specially designed for the service engineer by General Chemical. It's a combination carrying tool and wrench. We call it a "Caddy-Wrench." And, like the "Jug-a-Lug" which we created for you two years ago, this is a tool that's really helpful, really useful.

Many uses! As a carrying tool, the "Caddy-Wrench" makes it easy to carry small size cylinders by the hood. *No more cuts, strains and finger injuries!* And as a wrench, it's designed to fit "Genetron" cylinder valve stems and valve outlet caps, also stems of compressor service valves, soldering gas cylinders, etc. *No more adjusting wrenches or using different tools, once you have this all-purpose cylinder wrench and carrying tool!* Made of quarter-inch solid tool steel, it's strong, sturdy, won't crack, bend or break. And the smooth plated finish makes it a pleasure to use. Be sure you get *your* "Caddy-Wrench"! *Here's the only way to get one:*

SEE YOUR WHOLESALER! When you buy any size cylinder of "Genetron" 22—*between June 1 and August 1 only*—your wholesaler will be glad to give you your "Caddy-Wrench" . . . *free!*

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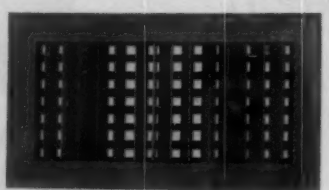
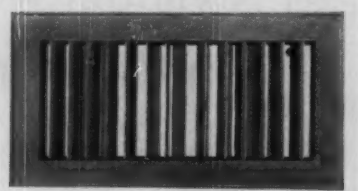
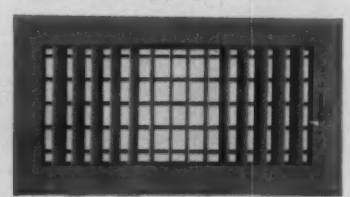


No. 190 & No. 191 Double Deflection Opposed Rear Valve Control



No. 192 Single Deflection Opposed Rear Valves



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PLUS any STYLE ASSEMBLY to Meet Any and ALL Competitive Specifications Plus SIX OTHER CATALOG ILLUSTRATED STYLE NUMBERS

U.S. 200 SERIES NON-FLEX REGISTERS and GRILLES (Return Styles)

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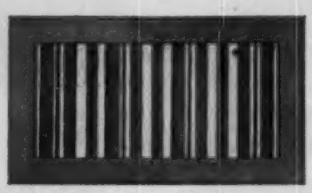
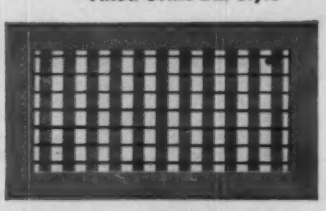
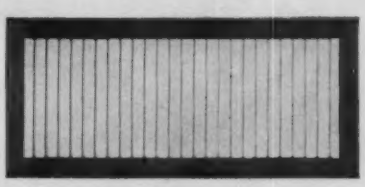


No. 200 Vertical Bar Style Opposed Rear Valve Control



No. 201 Horizontal Bar Style Opposed Rear Valve Control



No. 202 Vertical Grille Bar Nos. 203 — 204 Horizontal Bar

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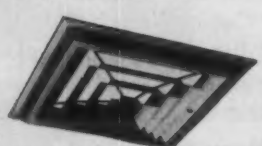
Knob Operation or Screw Driver Set for Unmolested Setting. Both Methods Combined in the Designing of the GEARED BI-VALVE DAMPER — The KNOBS SNAP ON and PULL OFF.



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UNITED STATES REGISTER COMPANY

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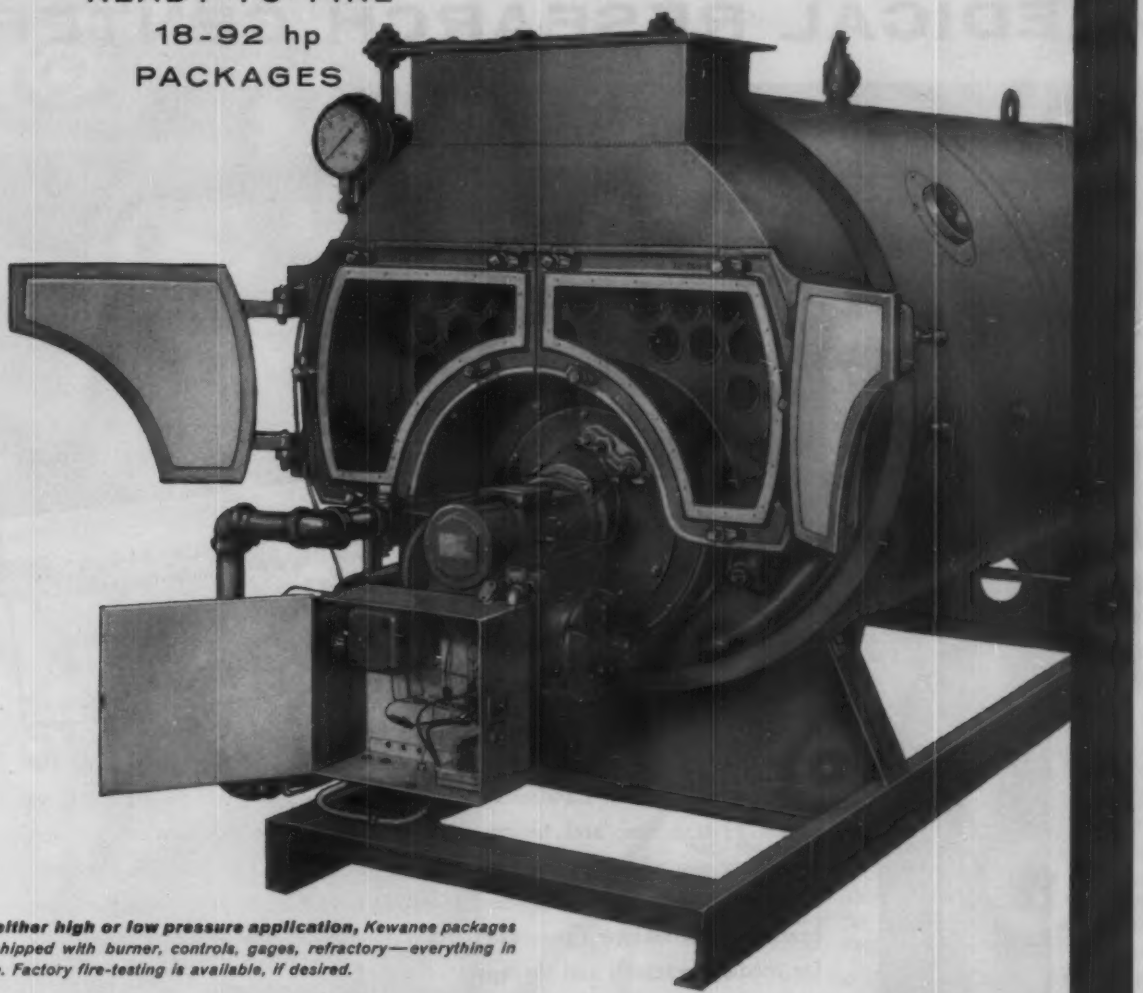
READY-TO-FIRE
18-92 hp
PACKAGES



***For either high or low pressure application,** Kewanee packages are shipped with burner, controls, gages, refractory—everything in place. Factory fire-testing is available, if desired.*

Put Kewanee quality and the package principle together on your next "under 100 hp" project. If it's a high pressure job, choose from 8 packages ranging from 18 to 92 hp. For low pressure applications, Kewanee packages start at 606,000 Btuh and end, eight sizes later, at 3,091,000 Btuh.

These are famous Kewanee Scottie Jr. Boilers factory-teamed with Kewanee Burners for oil, gas or combination oil-gas firing. They arrive on the job ready to fire as soon as they are connected to fuel, water, steam, power and vent. Fuel changeover, in combination firing, is fast and can even be handled by automatic controls. Forced-draft firing eliminates a stack. No unit is higher than an 8-foot standard ceiling.

New literature has recently come off the press on these new Kewanee packages. If you haven't seen it, send the coupon at right to: AMERICAN-STANDARD, KEWANEE BOILER DIVISION, 115 Franklin Street, Kewanee, Illinois.

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☐ high pressure . . 18 to 92 hp, 125-150 lb wp

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General Contractor:	Malan Construction Corp.
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Now nearing completion, this modern medical center forms part of the Brookhaven National Laboratory at Upton, Long Island. It covers 2.7 acres of an 11-acre site, and houses research laboratories for medical physics, pathology, microbiology, biochemistry and physiology. The graceful, one-story structure also contains a 48-bed research hospital, an industrial medicine branch for Brookhaven personnel and a nuclear reactor designed specifically for medical research and therapy.

Here stands an architectural gem built for peak efficiency in every phase of operation. Here, as in project after project across the nation, Wheatland Steel Pipe was installed for its outstanding quality, dependable service and long life. Why not specify Wheatland Steel Pipe for *your* installations?

...pipe with the yearmark!

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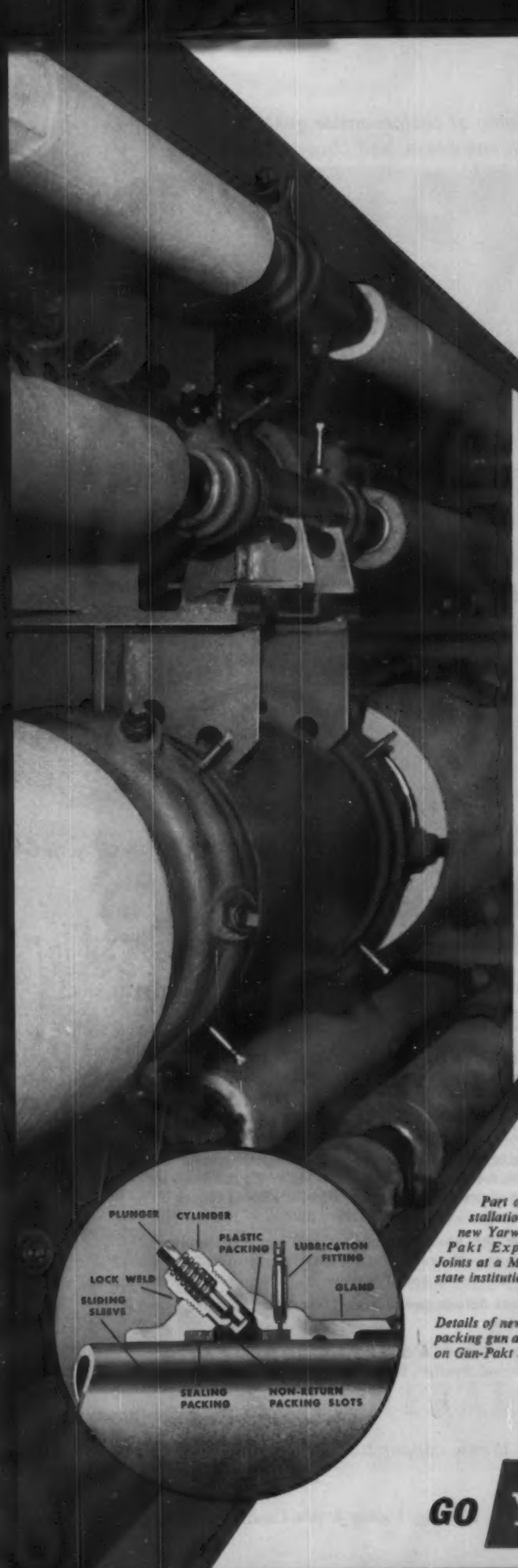

something great

has happened to steam lines..

..the improved

GUN-PAKT EXPANSION JOINT

Part of an installation of 37 new Yarway Gun-Pakt Expansion Joints at a Mid-West state institution

Details of new packing gun arrangement on Gun-Pakt Joints

With the many types of expansion joints available today for steam lines, it's important for engineers to "know their joints" when making a choice. Engineers know that Gun-Pakt maintenance costs have *always* been exceptionally low.

NOW . . . with the new Yarway Type W Gun-Pakt expansion joint you have these important *added* advantages—

CONVENIENCE—improved angle of packing guns makes them more accessible, thus reducing maintenance costs.

INCREASED STRENGTH—thanks to new one-piece integral body and gland.

LOWER MAINTENANCE—new packing gun design permits injection of special plastic packing *directly into packing space under full steam pressure. No need for costly shut-downs for repacking.*

Now is the time to find out more about Gun-Pakt joints. Write for Yarway Bulletin EJ-1916.

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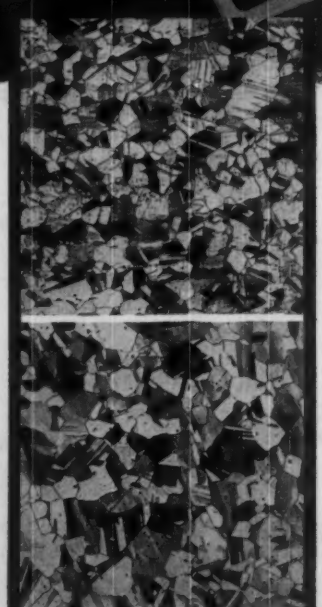

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CASE #102—Another case where General Electric Factory-Assembled Air Conditioning Units proved more practical than a field-assembled system.

The striking modern lines of the new Surety Life Building, Salt Lake City, Utah, pay tribute to the taste and skill of the architects. And the economical, Zone-by-Zone installation of General Electric Air Conditioning pays tribute to their judgement.

GENERAL ELECTRIC ZONE-BY-ZONE AIR CONDITIONING

meets all economy and performance expectations of architects in new Salt Lake City building

Beauty and function go hand in hand—with an incomparable degree of *comfort*—in Salt Lake City's new Surety Life Building. The architects chose a system of air conditioning as modern and effective as the architecture itself:—General Electric Zone-by-Zone Air Conditioning. Here's what Mr. Slack W. Winburn, architect-engineer, has to say about it...

"The General Electric Air Conditioners specified by us have proved highly satisfactory in the Surety Life Building. The points entering into our decision to specify General Electric Zone-by-Zone Air Conditioning offered the following benefits:

"1. Lower first cost, together with lower operating costs.

"2. Three zones of control per floor provide flexibility of control in the northern, central, and southern areas, thereby affording proper temperature control regardless of solar exposure, occupancy, or outside temperature.

"3. With the Zone-by-Zone conditioning approach, the large and long supply ducts normally used in a central-plant system were eliminated.

"4. The system allowed a layout of duct distribution between floors and the placing of diffusers and lights to a module between window mullions. This enables partitions to be moved without tearing into ceilings to make changes.

"5. One important consideration was the easily removable, sealed refrigeration units which can be replaced quickly if repairs are necessary."

We can add little to Mr. Winburn's words except, perhaps, to note that this case is typical of the results you can expect when you install General Electric Zone-by-Zone Air Conditioning.

General Electric's complete line is flexible enough to meet every air conditioning need for all types of buildings—large or small, old or new. Ceiling-mounted units, water-cooled, up to 7½ tons—air-cooled up to 10 tons. Floor-mounted units—water-cooled—up to 30 tons—air-cooled up to 20 tons. Steam and hot water coils available for all models. Discover how General Electric Factory-Assembled Units can simplify your job. For full details write: General Electric Company, Air Conditioning Department, 5 Lawrence Street, Bloomfield, New Jersey.

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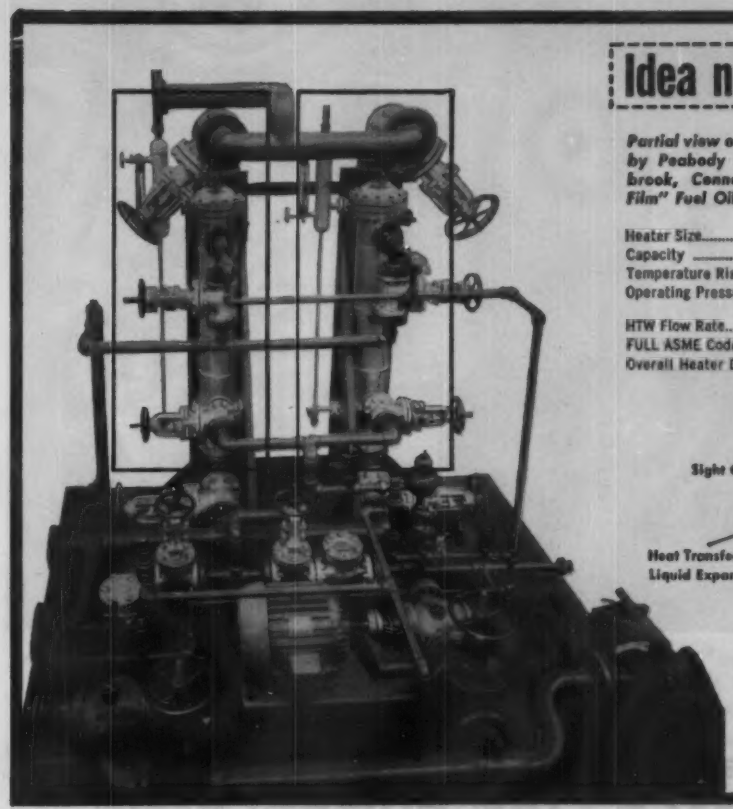
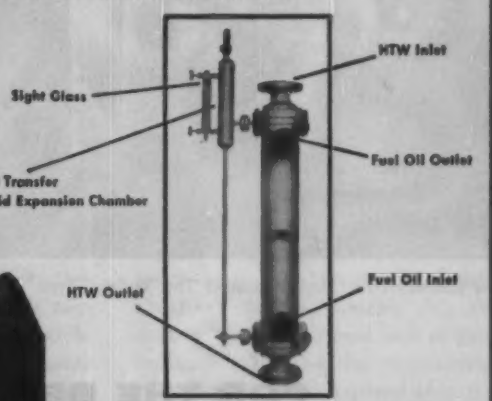


Idea no. 2 from Paracoil

Partial view of pump and heater set fabricated by Peabody Engineering Corporation, Glenbrook, Connecticut, utilizing two "Thermo-Film" Fuel Oil Heaters of these specifications:

Heater Size	FF-48 HTW "Thermo-Film"
Capacity	7500 lbs. No. 6 oil per hour
Temperature Rise	80°F to 210°F
Operating Pressures	300 psi, water side 315 psi, oil side
HTW Flow Rate	100 GPM at 370°F
FULL ASME Code Construction	
Overall Heater Dimensions	15" x 6'-6"



How to use High Temperature Water directly in a #6 oil heater...without danger of system contamination!

CUT ALONG DOTTED LINE AND SAVE

The Problem

The pre-heating of #6 fuel oil with High Temperature Water to provide adequate oil temperature and eliminate possibility of leakage of fuel oil into the HTW stream.

Leakage of fuel oil into the HTW stream would result in contamination of the system and could cause serious and costly damage to the boiler and the entire system.

The isolation of the fuel oil heaters can be accomplished by several methods. For example, the HTW stream may be passed through an evaporator to supply steam for use in a steam-type fuel oil heater. Or, the HTW stream may be passed through an intermediate water-to-water exchanger to heat a secondary water stream circulated through a water-type fuel oil heater.

In both of these systems, the HTW stream is safely isolated from the fuel oil heater by an intermediate secondary circuit. But effective as these methods are, they both require a minimum of two heat exchangers, additional space and additional connecting piping, regulators, level controls, etc.

A New Solution

Now for the first time the Paracoil "Thermo-Film" Fuel Oil Heater furnishes the optimum solution to the problem. **In a single exchanger** the "Thermo-Film" Heater provides adequate oil temperature, isolation of the HTW circuit from the oil circuit, a reduction in space requirements, simplicity of operation and substantially lower initial installation cost. A number of double tube elements are enclosed within the heater shell providing three circuits: the primary HTW circuit, an intermediate heat transfer fluid circuit, and the oil circuit.

The heat flow path is from the HTW to the heat transfer fluid to the fuel oil. In the rare event of an oil tube failure, the free oil cannot contaminate the HTW stream as it becomes trapped in the intermediate space containing the heat transfer liquid, and gives warning to the operating personnel by rising in the indicating gauge glass at the expansion chamber.

Your inquiries for Paracoil "Thermo-Film" applications to HTW systems are invited.

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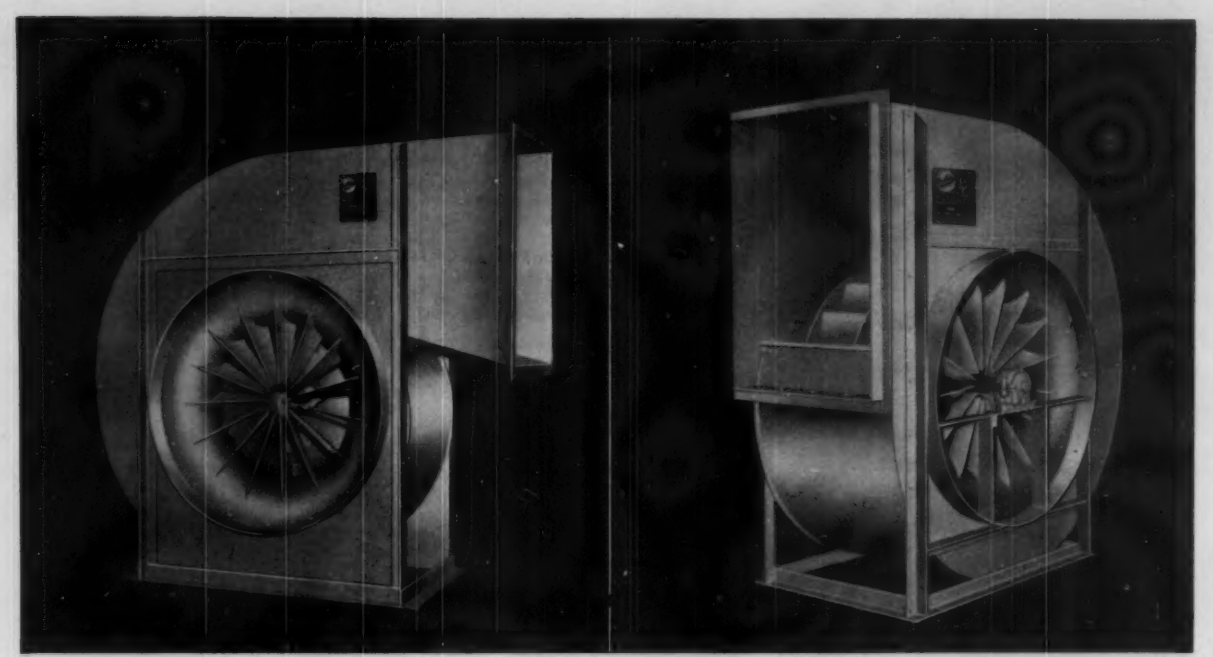

For Classes III-IV (High Pressures) The "Buffalo" Type "BLH" Fan

For Classes I-II (Moderate Pressures) The "Buffalo" Type "BL" Fan

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The "Buffalo" Type "BLH" Fan is recognized by engineers and contractors alike for its outstanding performance in Classes III and IV service. The "BLH" maintains an extremely high mechanical efficiency of 86% over a broad operating range. The smooth inlet bell with matching shroud, directional inlet vanes, backward-curved blades and divergent outlet all contribute to quiet operation and minimum turbulence. "Buffalo" engineering features, plus husky construction, add up to an efficient high pressure fan that will deliver long, faithful, maintenance-free service. When you plan a conduit system or other Class III-IV installation, be sure to specify the "BLH". Call in your "Buffalo" representative or write for Bulletin F-200.

The "Buffalo" Type "BL" Fan has gained wide acceptance for peak performance in major Class I and II installations throughout the country. Non-overloading, the "BL" provides quiet, stable, output from free delivery to shutoff. The smoothly-curved inlet bell, with directional guide vanes and matching shroud, assures minimum turbulence. Highest efficiency is attained by the streamlined wheel with backward curved blades, factory tested and balanced to hold vibration to an absolute minimum. The correctly shaped scroll of the wheel-contoured housing further contributes to smooth air flow. For full information on the rugged, reliable "BL" Fan for Class I and II conditions, contact your "Buffalo" engineering representative. Or, write direct for Bulletin F-104.

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Market Survey Predicts Air Conditioning Growth

. . . 20 percent increase in '58

A TREMENDOUS POTENTIAL for air conditioning commercial and industrial business establishments is seen by E. I. Du Pont de Nemours & Co., in a market survey report pinpointing nonresidential areas of growth for the air conditioning industry.

In fact, a report of the company's "Freon" Products Div. told delegates to the annual meeting of the Air-Conditioning and Refrigeration Institute, Inc. at Hot Springs that manufacturers of cooling equipment might well look forward to selling to about 300,000 of those establishments in the next year.

That is the number, according to a nationwide survey just completed, who said they plan to purchase air conditioning equipment within the next 12 months.

If survey respondents follow through on current plans, Du Pont market analysts said, 1958 will see an increase of 20 percent in the number of commercial-industrial establishments equipped with mechanical cooling systems.

In addition to new installations, the survey indicates, 24,000 owners of currently air conditioned quarters plan to add to their present cooling systems within the next year, while 29,000 owners intend to replace existing equipment.

Survey conclusions are based upon interviews with 2637 business establishments out of a national probability sample of 16,365 establishments in 103 localities. Nine basic types of commercial-industrial establishments were included in the survey, which covers essentially all nonresidential establishments in the nation.

Preliminary findings indicate that from a tonnage standpoint the industry's greatest sales potential exists in the retail establishment category. Based upon averages of the equipment now in use in such establishments, the 2¼ million currently non-air conditioned stores and shops in that classification represent a potential of about 20 million tons of cooling capacity. The approximately 1 million non-air conditioned business establishments comprising the remainder of the commercial market could easily absorb 13 million tons of cooling, Du Pont estimates, while the 180,000 industrial establishments not now air conditioned could account for 1.5 million tons of new refrigeration capacity. ≠

MCAA, NAPC Study Merger

. . . want local identity retained

THE executive committees of the Mechanical Contractors Association of America and the National Association of Plumbing Contractors have approved a resolution calling for consolidation of the two organizations.

The resolution stresses that plans for the proposed merger should include "proper safeguards for retention of local identity and autonomy."

The proposal would be submitted at the respective conventions of the two groups next year, according to the resolution. ≠

Engineers Council Adopts New Statement of Ethics

. . . worded in "plain English"

"HIGH SOUNDING phraseology and idealistic statements are not sufficient in defining conduct for engineers when it comes to professional ethics."

So spoke the newly elected president of Consulting Engineers Council, Charles C. Pate, of Tulsa, as he addressed the council's second annual board of directors' meeting held recently in San Francisco.

"A detailed code, written in plain English, and as easily understood as the Ten Commandments," was proposed by Mr. Pate as an answer to this need.

Discussion of ethics came about as a result of a report submitted by the council's ethical practices committee. In making his report, Committee Chairman Joe Williamson, Jr., declared: ". . . the present lack of professional ethics in the engineering profession is so widespread that the time has come for plain talk. Unprincipled people can only understand fighting language."

The committee went on to recommend the following statement of policy, which was adopted by the board.

A consulting engineer shall not share fees except with other registered professional engineers or registered architects. In no case shall so-called split fees, finder's fees, commissions, kickbacks, or other benefits be condoned. It is to be understood, however, that interprofessional practice (for example, with architects), on the basis of any recognized ethical contractual basis, is approved. Furthermore, in soliciting work, a consulting engineer shall be represented only by those individuals regularly employed by, or known to be associated with, his office.

Other business covered by the council at its annual meeting included the acceptance of the Consulting Engineers Association of Michigan, and the Houston chapter of the Texas Association of Consulting Engineers to full membership in the growing organization.

Approved by the board were resolutions providing for the acceptance of members-at-large in states or areas in which no consulting engineering association is now in existence. This offers a drastic change from previous

policy which restricted membership to associations, rather than individual firms.

Also of importance was the adoption of a California Association proposed resolution regarding procedure for answering requests for bids for engineering services.

It shall be considered unethical practice for any member of the Consulting Engineers Council to submit a quotation for engineering services which is solicited by mail, or in any event where he has reason to believe that other engineers are being requested to submit a quotation for the same services.

Elements considered to constitute a quotation include: Total fee, fixed fee, percentage fee (other than by reference to an established and recognized fee schedule), manhours, hourly rates, or any combination of such elements. Replies to such solicitations shall be limited to listing technical qualifications and availability." ⫩

Construction Contracts Off 12 Percent in March

. . . down 11 percent in first quarter

CONTRACTS for future construction in the U. S. in March totaled $2,721,228,000, a decrease of 12 percent compared to the like 1957 month, according to F. W. Dodge Corp.

Contracts for nonresidential buildings in March amounted to $967,102,000, down 11 percent from a year ago. Within this category, decreases were registered again in contracts for commercial and manufacturing buildings. These were 18 and 38 percent, respectively. Educational and science buildings were down 2 percent. However, contracts for hospitals showed a 17 percent increase.

In the residential building category, contracts for March totaled $1,070,556,000 down 3 percent compared to March 1957. Large residential building contracts showed a gain of 29 percent in dollar volume, but this was more than offset by a decrease of 8 percent in contracts for one- and two-family houses.

The total number of dwelling units reported in March was 85,218, an increase of 1 percent above March a year ago. While the number of one-family dwelling units decreased 9 percent, the numbers of units of apartments and two-family houses showed substantial increases.

Dollar volume of contracts in March in the heavy engineering category totaled $683,570,000, down 22 percent compared to the like 1957 month. Public works and utilities both registered decreases.

The cumulative totals of contracts for the first quarter of 1958 amounted to $6,721,767,000, down 11 percent from the like 1957 period. Totals in the major construction categories showed: nonresidential, at $2,466,106,000, down 13 percent; residential, at $2,567,698,000, down 8 percent; and heavy engineering, at $1,687,963,000, down 12 percent. ⫩

5th Apprentice Contest Set for August 10-15

. . . at Purdue University

THE FIFTH annual international contest for pipe fitter apprentices will be held at Purdue University, Lafayette, Ind., August 10-15, according to Joseph P. Corcoran, director of the training department of the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the U. S. and Canada.

Participants will be fifth year apprentices who are members of a local union of the UA who are winners of state or provincial fifth year apprentice contests. Only one from any state or province may enter. ⫩

Central Air Conditioning Shows Gain in N.Y.C.

. . . over 40 percent of major office space

MORE THAN 40 percent of all office space in major New York City office buildings will be made comfortable this summer by central, full building air conditioning systems, says Albert Baum of the Jaros, Baum & Bolles consulting engineering firm.

In a study based on construction and air conditioning installations since World War II, Mr. Baum estimated that buildings in the Manhattan business districts alone account for over 33 million sq ft of rentable space serviced by central systems. With the installations now being made, the total will be more than 40 percent of available office space.

With thousands of offices in other buildings rendered habitable by self-contained or packaged systems serving all or part of a single floor, and other offices cooled by room air conditioners, Mr. Baum declared that New York City may well be the most thoroughly air conditioned city in the world, after Dallas and Houston.

Altogether, he pointed out, there are approximately 5 million sq ft of additional office space air conditioned by central systems since last summer. ⫩

Revised Curricula Needed For Balanced Education

. . . too much science bad as too little

OVEREMPHASIS of science in education at the expense of liberal arts is just as bad as too little science, Dr. John T. Rettaliata, president of Illinois Institute of Technology, believes.

Science and liberal education are complementary, not conflictive, he says, and high schools, which play a major role in meeting today's challenge, should revise their curricula to require more strict minimums. ⫩

"Quote"

"Clothing spoilage from perspiration and airborne dirt has been reduced as a result of air conditioning our stores. More customers have come into our stores during the hot summer months. Employees have enjoyed the healthier, more comfortable working conditions and have done a better selling job."—*Harold Rosner, president, Robert Hall Clothes, Inc.*

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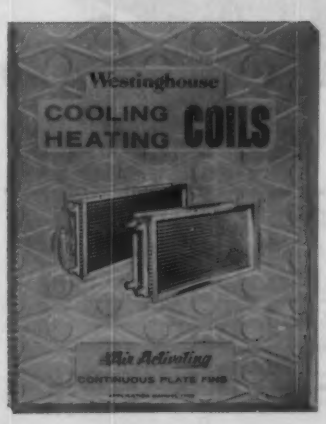

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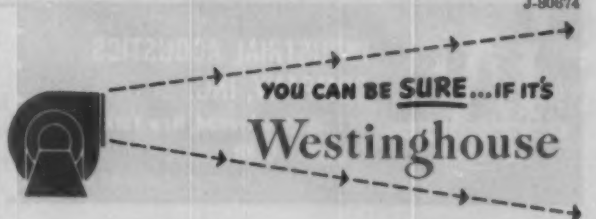

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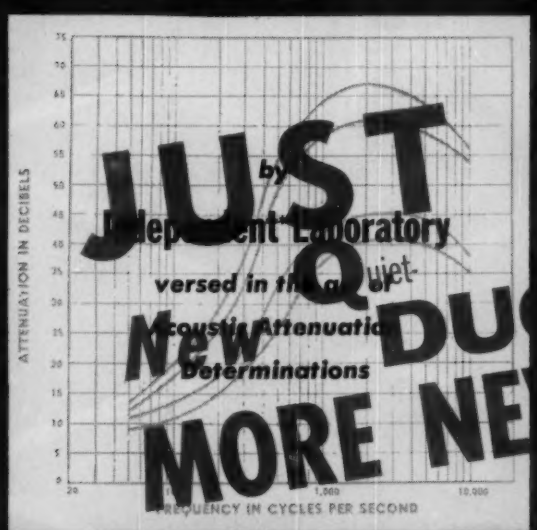

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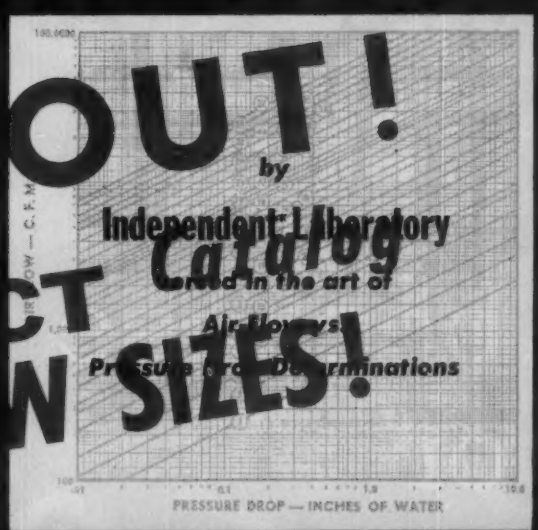

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*"Independent" should mean "without any vested interest" in any patents, or assignments of patents, or any royalty agreements for such devices.

*"Recognized" should mean acknowledged or skilled in a specific field.

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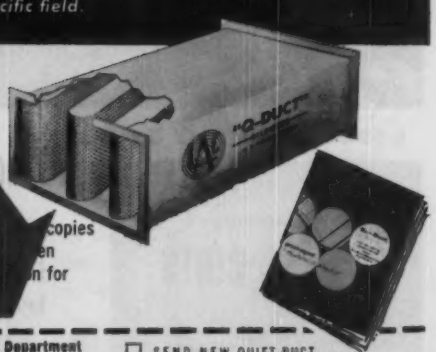

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AC 56

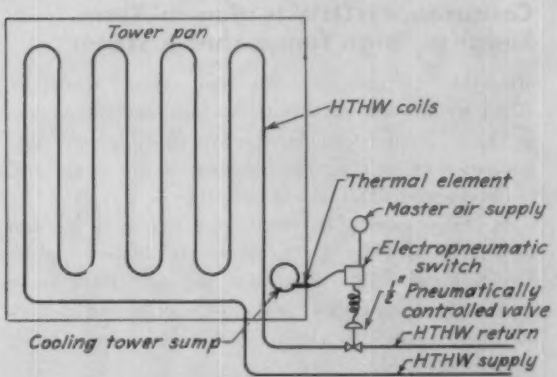
"Open for Discussion"

• *WE FOLLOW HERE each month the practice at engineering society meetings of providing an "open for discussion" period. You are urged to take part. Just address your comments to the Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.*

Why Is High Temperature Hot Water Used Directly in Cooling Tower?

IN THE September 1957 article, *Multiple Plant's HTHW System Provides Direct Heating, Supplies Low Temperature Hot Water, Furnishes Process Steam,* describing Johnson & Johnson's new manufacturing center at New Brunswick, N. J., it was stated that high temperature hot water is used directly in the cooling tower. Why and how is this done?

Our purpose in supplying hot water to the tower is to prevent tower freeze-up. The water is circulated intermittently as necessary to heating coils located in the tower sump. Flow is controlled through a pneumatically operated valve on the return line. This arrangement is illustrated in Fig. 1.



1 TO PREVENT TOWER FREEZE-UP, thermal element in tower sump controls pneumatic valve on high temperature hot water return line from tower. As outdoor temperature drops near 40 F, electrical circuit opens master air supply through electropneumatic relay to modulate valve which permits water to flow through coils. In this way, temperature of tower basin is kept between 40 and 42 F

W. F. CHINERY
Supervising Engineer
Johnson & Johnson
New Brunswick, N. J.

"Cooperator" Training Pays Dividends In Aircraft Turbine Plant Operation

REFERRING to my articles, *Package Units Aid Central Plant; Condition* 190,000 *Sq Ft Offices,* in the November 1957 issue, and *Unusual Air Conditioning System Meets Exacting Tolerances,* in May 1958, I would like to add the following comments:

At the Evendale, Ohio, plant of the Aircraft Gas Turbine Div. of General Electric Co., where jet engines are developed and manufactured, we have many types of air conditioning, heating, and ventilating systems. These are spread throughout numerous buildings containing at least 5.5 million sq ft of floor space.

Over 9000 tons of air conditioning capacity is available for the control of conditions in office areas, various types of laboratories, computer rooms, standards rooms, reproduction areas, and certain machinery assembly and process areas. The men who operate this equipment must be familiar with the purpose and proper regulation of approximately 3000 controls. The final results depend upon their knowledge, ability, confidence, and attitude.

We are in our second year of a training course for these "cooperators." We utilize as instructors the representatives of the suppliers of controls and other types of equipment used in the plant. In regard to more general knowledge, interplant relations, and certain specific subjects, we utilize personnel within the plant. Self-expression and development is particularly featured. Each man is not only encouraged to express himself but has his turn at addressing the group.

These discussions center around such topics as (1) under which circumstances we might have a surplus or lack of capacity of heating or air conditioning, (2) how our control or distribution might be improved, and (3) how we could use to advantage different types of controls, traps, dampers, or other devices. The men acquire a better knowledge of the operation of the various types of equipment and, consequently, display more initiative and ability in observing corrections that must be made due to alterations and changes in production layouts which may occur quickly.

The results have been more than worthwhile. Not only have the men increased their knowledge, they also realize they are part of the team. Naturally, they are more confident and proud of their ability. We continually analyze their reports for future training material, knowing that this will result in satisfaction for the "cooperators" and help the company to conduct a better training course.

C. F. MOWREY
Production Engine Dept.
Facilities Section
Aircraft Gas Turbine Div.
General Electric Co.
Cincinnati, Ohio

Query Sam Lewis on His Preference For Vacuum Pump in Steam Heating

SOME of the statements on Sam Lewis' Page, *Vacuum Pump Would Have Prevented Costly Troubles of Heating System*, in the January issue seem questionable to me. Possibly Mr. Lewis could explain these.

He does not explain why he favors the obviously more expensive vacuum pump method of reducing air concentration in gravity return two-pipe heating systems instead of nonreturn vents, which he recommends also.

Assuming that all of the heat transmitters are equipped with thermostatic traps the same as the ends of all supply mains, a swing check valve in each of the five return mains together with nonreturn vents would serve the same purpose as float traps. The vents would prevent re-entry of large quantities of air, and the check valves would prevent water from backing into each circuit from the other circuits due to vacuum induced by condensation of steam in the transmitters after the automatic temperature control valves close.

Many vacuum pump installations depend on swing check valves to prevent re-entry of air and condensate.

R. A. PARSONS
Board of Water and Light
Lansing, Mich.

THE AUTHOR'S REPLY—This is in keeping with the hornets' nest I can stir up every time I tell of unhappiness about steam heating systems that use a mixed gas like air in connection with reasonably pure steam as a heat transporting agent.

A nonreturn air valve is admitted by me as preferable to an air valve that breathes the unwanted air out and then invites the air to return.

I am not selfishly nor financially interested in vacuum pumps. I recommend them because they appear to serve admirably and enduringly year after year as auxiliary to steam as a heat transporting agent. It might be that the large steam heating systems that have these vacuum pumps are more intelligently designed as to drainage pitch and as to size of pipes than are some of the air vent steam heating systems.

I am not at all impressed by experience and observation with the operation of swing check valves as one-way gates on the ends of return mains. They do not consistently prevent re-entering of air, and to open one for release of water requires a head of several inches of water.

SAMUEL R. LEWIS
Consulting Mechanical Engineer
Chicago, Ill.

Industry Is Full of Terminology That Confuses Instead of Clarifies

I AM very interested in the comments by Erik B. J. Roos on the "Open For Discussion" pages in April about the use of the terms *high temperature hot water* and *hot water boilers*. I am in agreement with him and feel strongly that the entire industry is full of terminology, both old and new, which tends to confuse rather than clarify.

Some of the terms which should be replaced are:

1) *EDR*, which is 240 Btu per hr when using steam and varying amounts of energy for different temperature hot water systems;

2) *Boiler horsepower*, which is tied down to 33,475 Btu per hr but has nothing at all to do with horsepower; and

3) *Apparatus dewpoint*, which has two meanings:

a) *Coil or equipment apparatus dewpoint*, which I think should be more logically called *effective surface temperature;* and

b) *Room apparatus dewpoint*, which is defined as the intersection of the sensible heat ratio line with the saturation curve on the psychrometric chart. This is entirely unnecessary and does not simplify the solution of any problem as far as I can see.

I would be interested in hearing comments on these points as well as knowing whether any effort is being made to eliminate some of these terms.

EUGENE STAMPER
Assistant Professor in Mechanical Engineering
Newark College of Engineering
Newark, N. J.

Concur that HTHW Is Illogical Term, Suggest "High Temperature Water"

MR. ROOS's comments are well taken. When, in 1936, we introduced this type of commercial system in the U. S. and Canada, it was called *high pressure hot water*, or *HPHW*. This designation also conformed to the descriptive term used in Europe.

In this country this terminology has been switched to *HTHW* which, as he points out, is not very logical. For that matter, the term *high pressure*, while being more appropriate, may now also be criticized in view of the prevailing modern trend in very high boiler pressures.

The designation *high temperature water* is short and precise, and should be used.

J. F. GSCHWIND
Vice President
Research and Development
J. O. Ross Engineering Div.
Midland-Ross Corp.
New York, N. Y.

Correct Identification of Insulation Used in N.Y. Airport Piping System

IN THE article, *Huge HTHW System Supplies Unique Heating-Cooling Operation*, by William T. O'Reilly, in the February and March issues, it was erroneously stated that the insulating material used in laying the underground piping was a "pulverized natural asphalt." This terminology is somewhat misleading, and the material should have been identified in the article as "asphaltite."—Ed.

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Question of the Month

How Do Wind Loads Affect Stability of Pipe Supports?

This question was asked previously in Heating, Piping & Air Conditioning and is repeated here, along with answers that have been received from readers. Another answer appeared in the May issue. Other comments for publication are invited.

"We understand that wind loading on pipes is often included in some general provision for lateral stability in designing the supports for partially shielded piping. How to include these factors in the design of such piping is of real interest to us. What shielding effect from wind, if any, can be expected from one pipe on another which has been placed behind it? A brief statement of our immediate problem is as follows:

"The pipe supports will carry 60 pipelines varying in diameter from 2 to 6 in. This will be arranged in four layers and will cross an open field.

"The locality is subject to hurricanes. Therefore, we have been using a design wind velocity of 120 mph.

"The pipelines will be subjected to no thermal expansion, as very little temperature change will occur during or prior to their use.

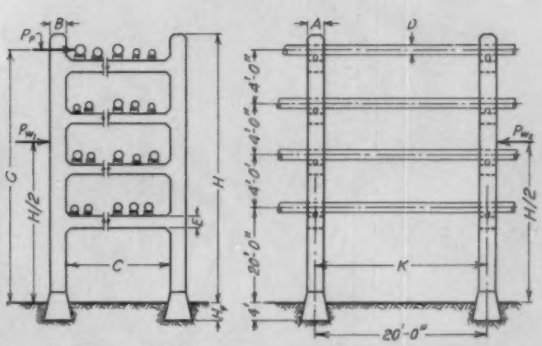
"All piping will be supported by precast concrete supports, with bell bottom foundations spaced 20 ft apart.

"The pipe load will be transmitted through guides to the supports. Pipes should be anchored firmly so that they cannot be blown off their supports. The lowest layer of pipe is to be 20 ft above the ground, with 4 ft between pipe layers.

"We feel that the wind loading and the effect of one pipe shielding the other is critical in the design of the supports. We would like to have information that will provide a firm basis for assuming wind loads on this type of installation." — D.S.F.

Wind Conditions Are Design Bases For Supports' Structural Components

FOR THE DESIGN of the pipe supports described by D. S. F., the effect of wind is important and must be considered. Fig. 1 shows applicable dimensional data for conditions prevailing when wind is acting upon vertical bents and horizontal pipes. The following formulas may be employed for determining the respective values:



1 DIMENSIONAL DATA for conditions prevailing when wind is acting upon vertical bents and horizontal pipes is shown here. Nomenclature is explained in text

$$P_f = (0.004 \times h \times V^2)/30 \quad [1]$$

$$P_{w1} = P_f \times A \times H \quad [2]$$

$$P_{w2} = P_f\ (2BH + 4CE) \quad [3]$$

$$P_c = 0.60\ P_f \quad [4]$$

$$P_p = P_c \times D \times K \quad [5]$$

$$M_1 = P_{w1}\ [(H/2) + H_1] \quad [6]$$

$$M_2 = P_{w2}\ [(H/2) + H_1] \quad [7]$$

$$M_p = P_p\ (G + H_1) \quad [8]$$

where:

P_f = wind pressure on a flat surface, psf

h = barometric pressure, in. Hg

V = wind velocity, mph

P_{w1} and P_{w2} = total wind force on bent, lb

P_c = wind pressure on cylindrical surface, psf

P_p = total wind force on cylindrical surface, lb

D = outside diameter of pipe or insulation, ft

K = pipe length between supports, ft

M_1, M_2, and M_p = bending moments about base of support, ft-lb.

PROBLEM

SOLUTION.

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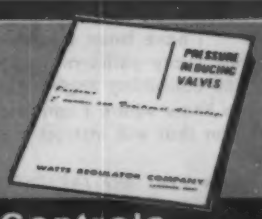

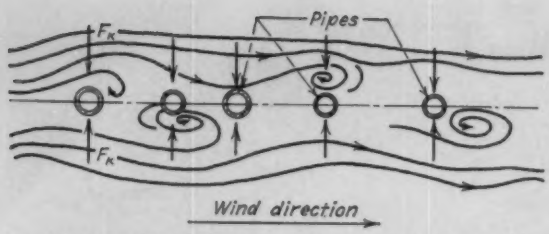

2 STRESS PROBLEM may exist resulting from eddies acting upon adjacent pipes. Phenomenon, called Karman vortices (F_K), arises from self-excited vibrations

Numerical values derived from these relations serve as a basis for designing structural components from which the pipe supports may be constructed.

The effect of wind forces acting upon piping is influenced by pipe size and location. These relations are illustrated by the following example. Assume that a 6 in. pipe is installed on the highest support and that the barometric pressure is 30 in. Hg. Then:

$P_f = (0.004 \times 30 \times 120^2)/30 = 57.6$ psf
$P_e = 0.60 \times 57.6 = 34.6$ psf
$P_p = 34.6 \times (6/12) \times 20 = 346$ lb
$M_p = 346 \times 36 = 12{,}400$ ft-lb.

If the pipe is small and is located near the ground, the resulting forces and moments may be sufficiently small to allow their omission, as indicated by the following. Assume a 2 in. pipe is located 20 ft above the ground. Then:

$P_p = 34.6 \times (2/12) \times 20 = 115.3$ lb
$M_p = 115.3 \times 24 = 2760$ ft-lb.

Since wind direction and magnitude change with respect to time, possible reduction of forces due to one pipe shielding another should not be considered. However, a stress problem may exist resulting from eddies acting upon adjacent pipes. This phenomenon arises from self-excited vibration and is referred to as Karman vortices. These alternate clockwise and counterclockwise, causing periodic alternating forces to act in a plane normal to the wind direction. Fig. 2 shows this in detail. These relations may be expressed by the following equation:

$$f = (0.22 \times V)/D$$

where:

f = self-excited frequency, cycles per sec
0.22 = Strouhal number (dimensionless)
V = air velocity, in. per sec
D = outside diameter of pipe or insulation, in.

If the self-excited vibration frequency coincides with the natural frequency of the structure and/or pipe, a resonance condition will occur which may cause their failure.

H. B. WAYNE
Consulting Engineer
Woodhaven, N. Y.

Is Stability Condition Critical? How Much Expense Is at Stake?

IT IS PRESUMED that the mechanics of the forces and moments to arrive at stability are already known. However, there is not enough data in the question to decide if the condition is critical, or what fraction of the labor and material cost is at stake by being conservative. Stability is also a combination of base width and mass. The question does not define these.

ASA 58.1 contains information on allowance of wind pressure for structural design. Ordinarily, this weight of pipe and a reasonable width of pipe rack 10 ft or better at this height would not require very accurate wind factors. For a steady horizontal wind there would be lateral stability.

If the pipe is lightweight and empty, the use of 2 cu yd of concrete for each support (1 yd over each side at a 10 ft spread) would provide stability if a projected area of 80 sq ft for each support is needed with a 40 lb per sq ft wind pressure.

Since D.S.F. feels it is critical, it must be that a very light and narrow strip is desired at low cost. What is the total expense involved and what percent change will be caused per ton of extra weight in each support? Or, if weight is at a premium, how will extra width change the cost? From the answers to these questions the tolerance of the accuracy of the wind factor could be established.

If it must be less than ± 10 lb per sq ft, then further information is needed.

CHARLES S. PARKER
Piping Engineer
Allentown, Pa.

READER ASKS—

"How Can I Organize an Engineering Office?"

"I would like to know how to proceed to organize my own consulting engineering office.

"I have been a manufacturer's representative for many years and now would like to go into the consulting engineering business. I would like to know where I can find the necessary information that will instruct me in the legal and other phases of setting up the right kind of organization. Also, I am interested in obtaining information on planning and accounting procedures for this type of operation.

"Any information that is available in published form or as advice from readers will be greatly appreciated."—L.W.W.

• *YOU ARE INVITED to contribute a question for publication, or an answer to a published question. Please address your reply to the Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.*

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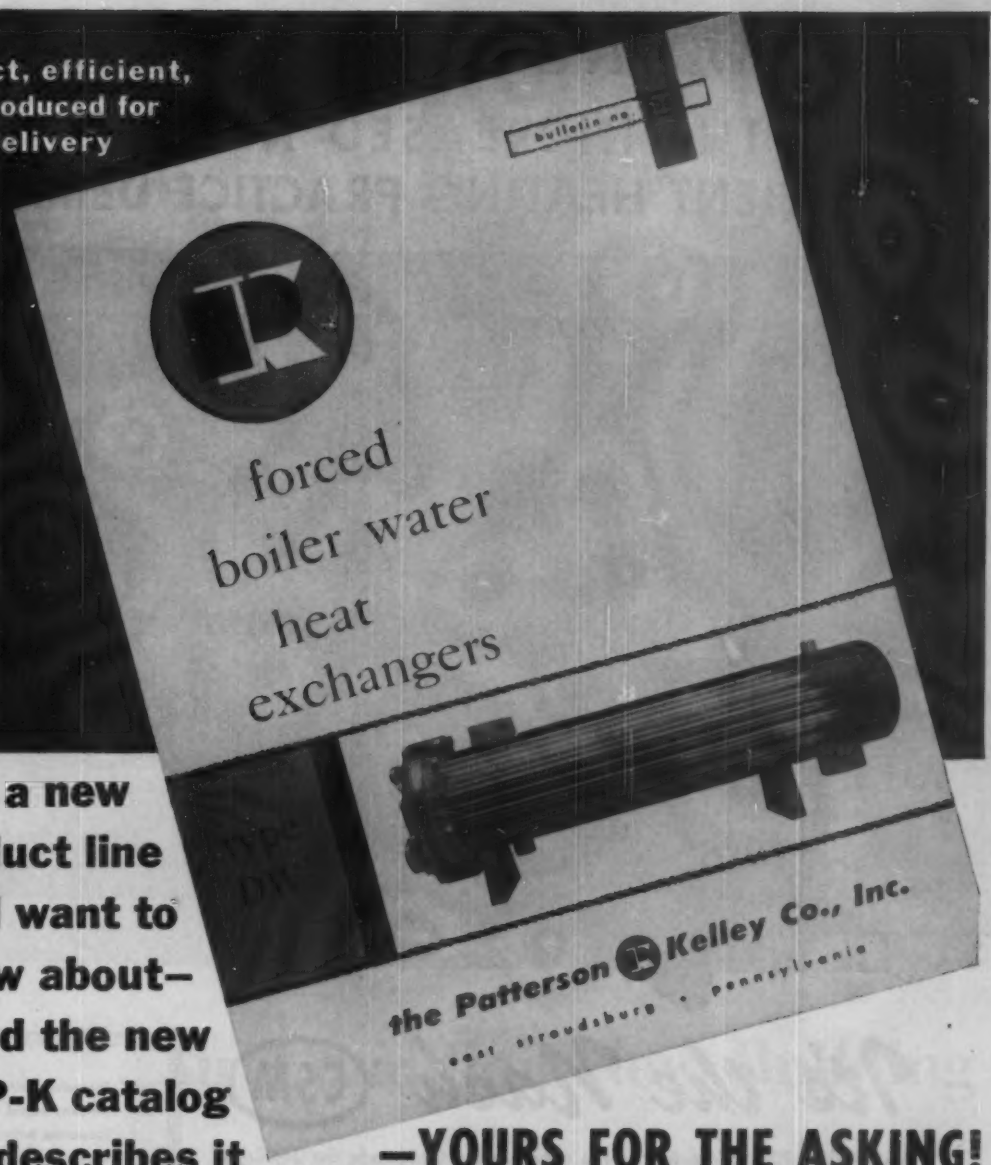

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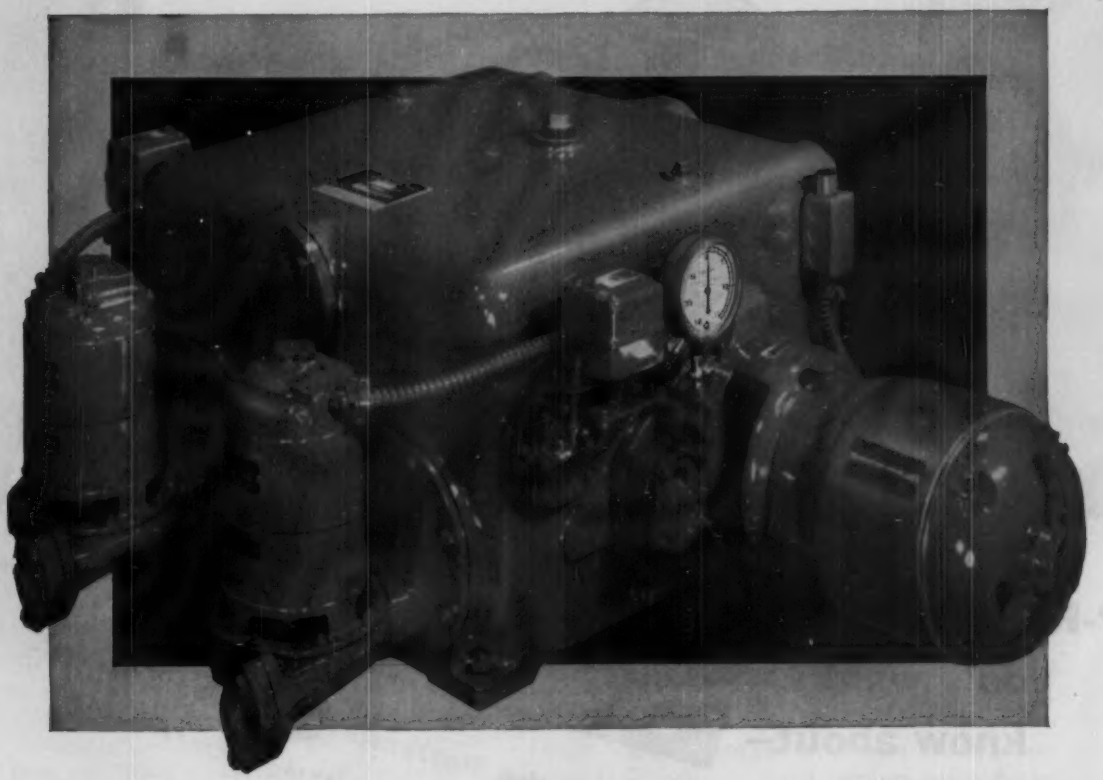

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Designed and manufactured by the organization that made the Jennings Manifold Heating Pump standard of the Heating Industry, the new CSM incorporates every desirable feature architects, engineers, owners and operators have sought. Employing separate air and water pump elements, each with its own motor and each independently controlled by its own automatic switch, the capacities and arrangement may be widely varied to meet job conditions. For the first time, the engineer has the choice of realistic water and air capacities required for rapid system response without wasteful overheating.

These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

- Increased air capacity induces rapid system response without wasteful overheating.
- Separate air and water pumps individually selected to meet actual job requirements.
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- Low, low, return line connection.

NASH ENGINEERING COMPANY
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FACADE of new Chicago Loop structure is 68 percent glass, 32 percent stainless steel. Windowless 25-story service shaft houses all building utilities, frees office areas from obstruction from same

Air Condition New Building Via Cellular Steel Floor

Chicago's recently completed Inland Steel Bldg. features innovation in air conditioning design. Cool or warm air, as supplied by five dual-duct high velocity systems, travels through cellular steel floors to perimeter outlets. Ceiling diffusers serve interior zones. Building's mechanical equipment includes snow melting system for sidewalk, garage entrance ramp, loading dock.

BY SAMUEL SACHS
Chief Mechanical Engineer
Chicago Office
Skidmore, Owings & Merrill
Architects and Engineers

THE NEW Inland Steel Bldg., the first major structure to go up within the Chicago Loop in more than 20 years, is the first large building utilizing a cellular steel floor in connection with air conditioning.

In order to establish the characteristics of this cellular steel deck prior

to its installation, an actual section was tested under simulated operating conditions. The data and test results formed the basis for final design.

This test program investigated such problems as total output, floor surface temperatures under various conditions of supply air temperature, room air temperature, velocity distribution, noise level as related to total air volume, condensation, rate of response due to varying air temperatures and air volumes through the cellular deck, and temperature gradients in the deck fill both horizontally and vertically.

Utilities in Building Core

The completely air conditioned structure consists of a 19-story, 252 ft steel clad office building with a 25-story, 332 ft windowless service shaft, a two-story annex building, and two basements below grade.

One of the unique features of the building is that all utilities are contained in the core which is external from the main office portions. This core carries the building power, communications, mail conveyor, elevators, steam piping, air conditioning ducts, chilled water and condenser water risers, plumbing, stairs, etc. The main office portion is therefore totally unobstructed by interior utilities.

The structural system of the main office portion provides columnfree spaces approximately 177 ft long × 58 ft wide. The building has four orientations, plus an interior zone.

The exterior of the main building is about 68 percent glass and 32 percent stainless steel. The glass consists of dual-glazed sections: heat absorbing on the exterior, regular plate on the interior. Spandrel panels are 16 gage stainless steel, backed by 2 in. of concrete fireproofing and sealed. The exterior of the core consists of a stainless steel clad concrete panel skin.

Design to Suit Architecture

In the design of the air conditioning system, the building architecture presented several requirements which had to be met. These were that the system (1) permit maximum economy of space usage and building volume; (2) maintain minimum floor-to-floor heights; (3) compensate for the large areas of glass; (4) compensate for the four orientations, each of which is exposed to solar gain and transmission; (5) compensate for the internal gain due to the high light level, occupants, and equipment; and (6) facilitate reducing the perimeter spandrel height to an absolute minimum.

The air conditioning system selected requires a minimum of space in the core and affords maximum overall economy. It provides maximum flexibility of temperature control within each space or possible future space division, allows the lowest configuration at the building perimeter, and permits taking advantage of the diversity of load between the four orientations and the interior zone from the point of view of reduction of peak refrigeration load.

5 Systems Condition Building

Air conditioning for the building is provided by means of five dual-duct high velocity systems. Four of the systems supply the third through 19th floors inclusive, handling either four or five floors per system.

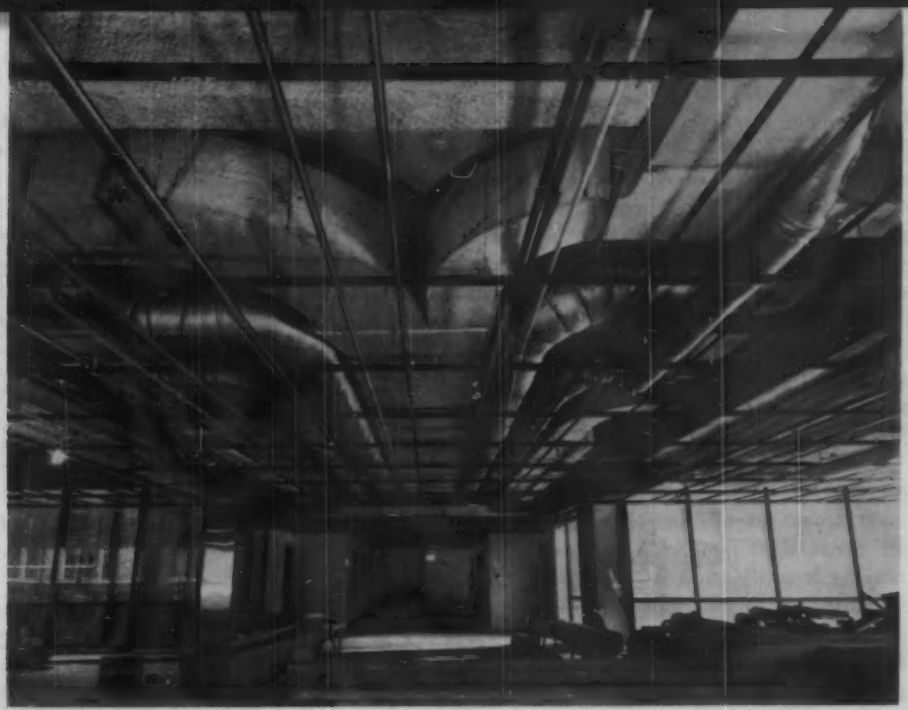
The fifth system serves the first two floors which comprise a separate area containing offices, the main lobby, and a two-story annex building.

Two of the air handling systems are in the 23rd and 24th floors of the penthouse. These downfeed the 19th through the 12th floors. The three systems serving the lower portion of the building are located in the sub-basement.

Each system consists of an apparatus containing preheating coils, automatic disposable filters, steam grid humidifiers, and two double width-double inlet fans which discharge into a plenum chamber containing a cooling coil and heating coil in parallel serving the cold and hot ducts. The main outside air intake for the systems is arranged so

What Is a Cellular Steel Floor?

Cellular steel flooring is comprised of two sheets of steel which have been formed together to provide 3⅛ × 3¾ in. channels for passage of air, and serve as conduit for utility wiring. Openings are cut in the bottoms of the channels to permit connection of the supply ducts, as shown at the left.



DUCTWORK for dual-duct high velocity air conditioning shown here during installation. Arrangement provided 1 ft reduction in floor-to-floor height, permitted construction of additional floor in building within area and volume limitations of building code. Five air handling systems serve building: two on upper floors of penthouse, three in sub-basement

that the outside air passes into the cold duct. This results in better control of humidity conditions in the summer and in a reduction in the outdoor air heating requirements in the winter.

Save 1 Ft Height per Floor

The air leaving the heating and cooling coils passes into ducts located in the core area duct shaft. On each floor, takeoffs are made which connect to horizontal ducts located above the suspended ceilings. These ducts pass through openings provided in the structural steel girders.

This arrangement permitted a reduction in floor-to-floor height of approximately 1 ft per floor. Construction of an additional floor in the building within the area and volume limitations of the building code was thereby allowed. Fire dampers are located at each floor takeoff from the vertical ducts.

The horizontal main supply ducts feed pressure reducing and sound attenuating chambers or sound boxes which are located above suspended ceilings on each floor. These sound boxes supply the interior zone or perimeter zone. Both zones, however, are fed from the same hot and cold ducts except on floors where systems overlap.

The discharge from the perimeter zone sound boxes is connected into the underside of the cellular steel deck through a plenum box which contains a fusible link fire damper. The air passes from the plenum box through the cells to the perimeter of the building.

There, it is discharged vertically upward into another plenum box containing an adjustable throat damper, and then vertically through supply outlets located at the curb in front of the glass. These perimeter outlets are located on 5 ft, 2 in. centers around the entire perimeter of the building. Each 5 ft, 2 in. module contains 10 cells 6 in. on centers. The middle six cells are used for air, and the end two are used for electric, telephone, and public address wiring. The air, in passing through the cells, either warms or cools the floor causing it to act as a radiant surface.

The underside of that portion of the steel deck which has been used as an air passage is sprayed with ¾ in. of thermal insulation. Below this has been installed the usual metal lath and fireproofing. Each cell of the cellular steel deck which is used as an air passage is individually sealed at each end by closure methods developed specially for the job.

Provide Control Flexibility

Each bay of the building perimeter consists of five 5 ft, 2 in. modules. These modules are served by four sound boxes. Two boxes are sized to accommodate two modules each, while the other two are sized for one module each.

The discharge ductwork from each two-module sound box is so arranged that any single module or group of modules can be arranged for individual or group control by revising the sound box discharge connections. This arrangement affords control on either an individual or modified zone basis as desired by each tenant.

The interior zone sound boxes, which are also connected to the horizontal mains suspended above the ceiling, supply air through perforated metal pan type of overhead ceiling diffusers. There are two interior sound boxes per bay and each

box supplies seven ceiling diffusers. The control of these boxes can be either on a zone basis from return air thermostats, or from room thermostats.

The air supply systems for the main building range in size from 57,000 to 70,000 cfm per system and are designed to operate at static pressures from 10 to 12.6 in. water gage. The supply system serving the lower two floors is rated 22,000 cfm.

Velocities in the main trunk ducts are about 6000 fpm. Velocities in the main trunk takeoffs on each floor are about 4000 fpm, with pressures ranging from 3½ to 1 in. WG.

Individual sound boxes are not provided with constant pressure or constant volume devices. The static pressure in the hot and cold ducts is regulated by a static pressure controller which senses pressure at the midpoint in the system. Dampers, located downstream of the heating coil and cooling coil in each duct, are modulated by this controller.

The supply and return air on each floor is approximately balanced, with some excess of supply over exhaust in order to maintain the building under slight positive pressure. The return air is taken through perforated metal pan type of ceiling diffusers which are connected to a high velocity return air system through air valves. The velocities between the ceiling diffusers and the air valves are conventional. Beyond the air valves, the velocity increases to about 3000 fpm in the main return riser.

Three ft of acoustical insulation is provided on the upstream side of each air valve to attenuate the air noise through the valve. The return air is taken to an exhaust recirculation fan which discharges the air either back into the supply system or to the outdoors, depending on the outside temperature conditions.

Meet Code Requirements

The perimeter outlets, overhead air diffusers, and lights are arranged so that partitions can be located at 5 ft, 2 in. centers in either direction throughout a floor. This requires no modification of the air supply or return system and still complies with the city ventilation code.

Complete access to the sound boxes and ductwork is afforded through the removable perforated metal pan ceiling. Where ceilings are plastered, access is through panels in the ceilings.

Added Air for Special Areas

Additional air quantities have been provided for such special spaces as the IBM room, board room, cafeteria, and various lounges. Exhaust from the kitchen and kitchen range hood is handled through a separate 14 gage, black iron duct system which is connected to an exhaust fan located on the upper penthouse floor.

The garage area in the first basement is mechanically exhausted in accordance with the code. Makeup air for this system is obtained from the entrance ramps and is heated by unit heaters located over the entrance doors. Areas below grade are mechanically supplied and exhausted. The boiler room has natural ventilation.

Steam for blast coils, domestic hot water heating, and snow-melting is generated by three combination gas-heavy oil packaged firetube boilers. Gas firing is under semi-automatic operation. The heavy oil firing is automatic, with a manual switchover from gas to oil.

The plant consists of two 17,125 lb per hr boilers, and one 6125 lb per hr boiler for summer operation. The design building heating and hot water load can be met by one large boiler and the small boiler.

Steam is piped to the various mechanical rooms and to the heating coils in the apparatus housing and domestic hot water generator located in the 23rd floor penthouse.

Melt Sidewalk Snow

Steel pipe snow melting grids are embedded in all of the sidewalk areas around the building, in the entrance ramps to the basement garage, and at the truck loading dock. The system is filled with a 50 percent solution of ethylene glycol with a corrosion inhibitor.

Perimeter radiation serves the main lobby area. This is supplied from a hot water circulating system located in the sub-basement mechanical room. Hot water is also supplied to unit heaters located over the main entrance revolving doors. Heating in the building stairwells is by means of steam convectors.

Chill Water to 42 F

Chilled water is generated in two 475 ton hermetic refrigeration units in the sub-basement. Water at 42 F is supplied to the cooling coils in the apparatus housings in the main supply systems. The coils are designed for a 12 F rise. Two pumps, each with a capacity of 950 gpm, circulate the chilled water.

Condenser water is provided by means of three cooling towers located on the roof of the building core. These towers are designed to handle 2380 gpm of condenser water entering at 97 F and leaving at 85 F, at an outside wet bulb temperature of 75 F. The condenser water is circulated by means of two pumps, each rated at 1190 gpm. An additional pump is piped and valved to serve as a standby for both the condenser water and chilled water systems.

Fire protection is in the form of a complete system of standpipe and hoses located on all floors through the 24th. A wet type of sprinkler system is installed in the advertising stock storage room, maintenance shop, boiler room, and kitchen. A dry type of sprinkler system protects the garage and truck dock area.

Hose cabinets in the office areas are served from risers located in the main core area. Connections between the hose cabinets and the core area run above the suspended ceiling. The sprinkler systems are supplied by a 750 gpm fire pump and a 35 gpm jockey pump designed to operate against a discharge pressure of 185 psi.

The mechanical (heating, piping, and air conditioning) contractor was Economy Plumbing and Heating Co. Narowetz Heating and Ventilating Co. and the Zack Co. installed the air distribution system. ⧺

Here's Short Cut To Pipe Line Erection Estimating

. . . experience recorded on repetitive jobs affords useful information which aids engineers in arriving at cost figures.

BY JAMES H. SHAW
Director
Laboratory Services Dept.
Carrier Corp.

ENGINEERS, through their on-the-job experience over the years, are able to develop valuable short cuts to aid them in their future estimating. Of particular value is data on manhour requirements for installation of various types of equipment. This data can consist of tables, curves, common sense, and just plain know-how.

Since written information of this type is empirical in nature, it must be used with caution by engineers other than the originator. Only he is completely familiar with his own data and, for a specific application, knows when to give a little and when to take a little.

Table 1 on the next page is an example of this type of data. It is based on several years of experience in installing and insulating piping. The time figures are average for both indoor and outdoor work. While the data is useful as a guide in estimating work covered by the table, the caliber and skill of the available labor must be considered carefully.

The figures given include average requirements for rigging, hoisting, scaffolding, getting equipment and materials on the work site, and removal of extraneous material when the job is completed. These costs can vary greatly up or down, depending on the environment at the work site. It is this supporting activity to the actual construction that requires careful consideration by all engineers engaged in this type of work. It is probably safe to say that, where piping jobs have been underestimated, the trouble usually will be found in this portion of the total job.

How to use the table in making manhour calculations of various installing and insulating steps is as follows:

• Joint Welding

The column headed *welding time per joint, hr* represents the total manhours required to complete one of several electrically welded joints in the pipe sizes indicated. The pipe location is considered to be overhead and accessible from a ladder or scaffold. Some time is allowed for installation of the means of access to the work. On the larger sizes of pipe, 8 in. and above, it must be kept in mind that the same means of access to the work is used to erect the pipe hangers and, in some cases, the lengths of pipe.

• Pipe Erection

Erection time, pipe figures represent average total manhours per linear foot of pipe. Some time for rigging and hoisting, cleanup, and moving equipment to and from the site is included.

In pipe sizes 6 in. and smaller, one

Prior to the present position held by Mr. Shaw, he was an engineer with Eastman Kodak Co.

pipe fitting every 10 ft is included in the estimate. If more fittings than this allowance are to be installed, reference should be made to the column under *fittings, bare* for the additional estimated time per fitting.

• Hanger Erection

In the *erection time for hangers* column the average manhours to fabricate the hanger material and to install one of several hangers are combined as a single item. The figures are on the basis of linear feet of pipe with average pipe spans used. On the smaller sizes of pipe, up to 4 in., the clevis type of hanger with a rod attached to an existing overhead structural member is considered. On the larger sizes, 10 in. and up, extra time is included for complete hanger fabrication and installation, including structural support members.

In an outdoor line where all new pipe bents with foundations, etc., are required, the large pipe figures are too low. Conversely, if the line is being installed on existing supports where only a pipe clamp and rod are required, the figures are on the high side. With this absurdity, one may well question the value of the figures. Again, it must be kept in mind that in some cases they only serve to determine the area of cost of this supporting activity.

The figures represent averages for many types of supports, including clevises, trapezes, rollers, double rod-half pipe clamps, single rod-full pipe clamps, and those with saddles over the pipe insulation.

• Cork Covering Installation

The three columns under *erection time, cork covering, pipe* consider the three thicknesses of cork insulation; i.e., light duty, standard duty, and heavy duty.

Although the figures represent average manhours per linear foot of pipe for cork insulation, they are suitable for other types of similar cold line insulating materials, such as the mineral, glass, or foamed plastic types.

The figures are intended principally for outdoor installations and include the normal vapor sealing and roll roofing installation. In addition, time for application of one coat of oxide paint on the bare pipe prior to insulating is included.

Since the data is based on cork covering, molded covering is assumed above the line in the area of the 12 and 14 in. pipe sizes. Lagged covering is assumed below this line. In the case of lags, the estimate includes the time required for cutting them from 12 × 36 in. sheet cork.

For indoor lines where roll roofing is not required, a suitable deduction is allowable. An appropriate figure would be about 40 percent.

Time is allowed in the figures for moving materials to the site, clean-

TABLE 1—MANHOUR REQUIREMENTS for various phases of pipe line installation are listed here. Figures are based on several years of experience in installing, insulating piping. Time figures are average for both indoor, outdoor work

Pipe size, in.	Welding time per joint, hr	Erection time, average manhours per linear ft							Fittings, hr each			
		Pipe[a]	Hangers, fabrication and installation[b]	Cork, including roofing, one coat of paint on pipe and cork[c]			85 percent Magnesia[d]		Bare[e]	Cork[f]	85 percent Magnesia[f]	
				Light duty	Standard duty	Heavy duty	Single weight	Double weight			Single	Double
½	0.167	0.264	0.21	0.202	0.213	0.234	0.084	0.126	0.068	0.34	0.34	0.52
¾	0.250	0.294	0.23	0.218	0.228	0.245	0.089	0.133	0.074	0.37	0.37	0.56
1	0.334	0.329	0.25	0.237	0.248	0.268	0.094	0.141	0.077	0.40	0.40	0.60
1¼	0.417	0.381	0.26	0.257	0.274	0.291	0.100	0.150	0.110	0.45	0.45	0.68
1½	0.500	0.442	0.27	0.274	0.296	0.308	0.107	0.161	0.148	0.50	0.50	0.70
2	0.667	0.496	0.29	0.302	0.324	0.339	0.114	0.171	0.176	0.58	0.58	0.87
2½	0.834	0.572	0.25	0.331	0.355	0.365	0.123	0.185	0.220	0.67	0.67	1.00
3	1.000	0.645	0.34	0.374	0.396	0.404	0.133	0.199	0.253	0.80	0.80	1.20
4	1.334	0.792	0.47	0.428	0.447	0.463	0.146	0.219	0.352	1.00	1.00	1.50
5	1.667	0.950	0.54	0.495	0.515	0.536	0.152	0.230	0.469	1.50	1.50	2.25
6	2.000	1.18	0.64	0.562	0.583	0.609	0.160	0.240	0.586	2.00	2.00	3.00
8	2.667	1.31	0.97	0.660	0.691	0.715	0.753	1.13	15	16	10	13
10	3.334	1.54	2.16	0.755	0.791	0.817	0.937	1.41	20	24	15	20
12	4.000	1.74	2.88	0.840	0.880	0.910	1.112	1.655	24	30	21	26
14	4.667	1.87	3.60	1.22	0.944	1.32	1.221	1.82	27	35	26	33
16	5.334	2.06	5.04	1.46	1.53	1.58	1.40	2.12	32	40	32	40
18	6.000	2.23	6.00	1.64	1.72	1.78	1.57	2.36	36	43	35	48
20	6.667	2.45	7.00	1.84	1.93	1.99	1.745	2.55	40	47	38	55
24	8.000	2.81	8.00	2.20	2.32	2.38	2.09	3.14	48	50	40	60

[a] Above the line, one fitting per 10 ft is included

[b] Below the line, complete structural support is included.

[c] Above the line, molded covering is assumed; lagged covering is assumed below the line. On all three thicknesses, deduct 40 percent when roofing is omitted.

[d] Above the line add 90 percent for roll roofing; below the line deduct 40 percent when roofing is omitted. Add 40 percent for painting one coat on all sizes.

[e] Below the line, two flanges, bolting, and welding are included.

[f] Below the line deduct 50 percent for pair of flanges. For all sizes deduct 40 percent for 90 deg gored elbow.

up, and some hoisting. However, on the large pipe sizes where lags are used it is assumed that the covering is applied to the pipe prior to hoisting it to its final location. After the pipe has been welded and leak tested, the remaining bare pipe joint would be covered in place.

• Magnesia Covering Erection

Under the heading *erection time, 85 percent magnesia covering, pipe* are columns for single weight and double weight magnesia covering for steam lines. The figures represent total average manhours per linear foot of pipe for installation under average environmental conditions.

Some time is allowed for equipment required for access to the line. The insulation is considered to be installed with the pipe in its final location. Also included is time to bring materials to the work site and to clean up after the completion.

For sizes 6 in. and less, the time required for roll roofing is not included since most of the installations upon which the figures are based were indoor lines. For outdoor work on these line sizes, when roll roofing is used, add 90 percent to the figures shown.

On line sizes 8 in. and larger, the roll roofing installation time is included. About 40 percent could be deducted from the figures shown for indoor lines in these sizes.

Where painting of the covering is required, about 40 percent should be added to the figures given for all sizes.

• Fittings Erection

The *erection time, fittings, bare pipe* column shows the average manhours required for the complete installation of one pipe fitting. These are average figures for valves, tees, and elbows installed during the course of a pipe installation where many fittings are involved. Thus, the data would not necessarily be valid for a single fitting installation.

On pipe sizes 8 in. and larger, the data is based on flanged valves, since it is assumed that welding elbows, tees, etc., would be used in most cases. In this category the time to install two welding type flanges, bolts, and gaskets is included. This same data is applicable to any other flanged fitting.

Time is allowed for hoisting the fittings into place, squaring up the pipe flanges, and the other necessary operations. It is assumed that scaffolding or other means of access to the work area is existing and in place.

When flanged fittings are used on sizes less than 6 in., appropriate increases in the time should be allowed.

Threading time is included in the erection time of small sized pipe and is not included in the fittings installation time.

• Cork Covering Fittings

The manhours under *erection time, fittings, cork covering* represent time to cover one fitting of a multifitting installation. It is assumed that access to the work area is existing and in place.

Molded covers are assumed on pipe sizes 6 in. and smaller. Above this size, lagging is assumed. Time is allowed for cutting the lags from 12 × 36 in. sheets. Although the figures are based on cork covering, they are applicable to other types of cold line insulation.

On pipe sizes 8 in. and larger, where lagged covering is used and only a pair of flanges are to be covered, deduct 50 percent from the time shown in the column. Molded covers for flanges are assumed on sizes 6 in. and smaller. In this case the time is averaged with that of valves and other fittings.

Since all voids between the covering and the pipe fitting should be filled, time is allowed in the figures for this, using melted paraffin and granulated cork.

For gored elbow covering on 8 in. or larger sizes, 40 percent may be deducted from the time shown for each such elbow. This fitting cover is merely lagged pipe covering cut transversely to fit the angle of the elbow.

• Magnesia Covering Fittings

In the two columns under *erection time, fittings, 85 percent magnesia covering* for single weight and double weight covering, the same general comments apply as for cork covering. In addition, time is allowed for plastering with magnesia paste to get a smooth finished job. Also, time is included for cloth covering. Time for painting can be calculated on the same basis as for straight pipe, but allowance for pipe size must be increased proportionately. ‡

Automobile Gas Exhaust Related to Type of Fuel

. . . according to research report

COMPOSITION of gases that blow out the exhaust pipe of an automobile have a direct connection with composition of the fuel that goes into an automobile gasoline tank.

This was reported in San Francisco recently to the American Chemical Society's petroleum division by William B. Heaton and Joseph T. Wentworth of the research staff of the fuels and lubricants department of General Motors Corp.

Their results were based on a new analytical technique they developed which combines gas chromatography with infrared detection. This technique determines individual hydrocarbons in the exhaust in concentrations as low as one part per million. Gas samples were collected during actual road tests with 1957 cars burning both commercial gasolines and pure hydrocarbons — such as benzene.

Mr. Heaton and Mr. Wentworth explained that exhaust gas from different commercial gasolines showed a similarity between the composition of the exhaust hydrocarbons and the original gasolines. These results were confirmed by the analyses of exhaust gases from pure hydrocarbons. ‡

INDUSTRIAL VENTILATION: How Is It Designed?

Will natural ventilation serve well for your building requirements? Or will it be necessary to go to a fully mechanical system to produce the desired environmental conditions? There is no pat answer. To arrive at his conclusion, each engineer must give his problem careful study, weighing all of the factors of cost, effectiveness, maintenance, and reliability.

BY JOHN H. CLARKE
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Air Conditioning and Power
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IN MODERN industrial building, ventilation is no longer a luxury. Instead, it is a necessity. Consequently, it is very important that the proper type of system be selected. Many types are available. It is the intent of this article to describe these principal types, explain their design requirements, and recommend where they should be used.

Unfortunately, tradition has played an all too important role in industrial ventilation design. Engineers and others involved should alert themselves to the improvements that can be made through the use of modern techniques and equipment.

Provide Natural Ventilation Two Ways

Natural ventilation is still used in many industrial areas and, where properly applied, will provide good building ventilation. There are two general types: convection ventilation, which can be designed for adequate, reliable ventilation; and wind force ventilation. The latter has very few practical applications in industry, as will be indicated herein.

Convection ventilation is best applied for areas in high shed type buildings (metals industries, glass manufacturing, kiln areas, and brine type salt plants) having 30 to 60 ft ceilings and hot equipment operations which will provide the convection force for air movement, as shown in Fig. 1 b. It is not suitable for the modern, wide, low type of building illustrated in Fig. 1a, where the convective forces are inadequate and the periphery inlets are ineffective in providing relief for the center areas because of short circuiting of the supply air.

Even where the convective force is available it should be kept in mind that it is of low magnitude. The inlets and outlets should be designed for low velocity, considering the head available. An approximate equation for such convection flow is given by the ASHAE Guide as follows:

$$Q = 9.4\, A\sqrt{h\,(t_i - t_o)}$$

where:

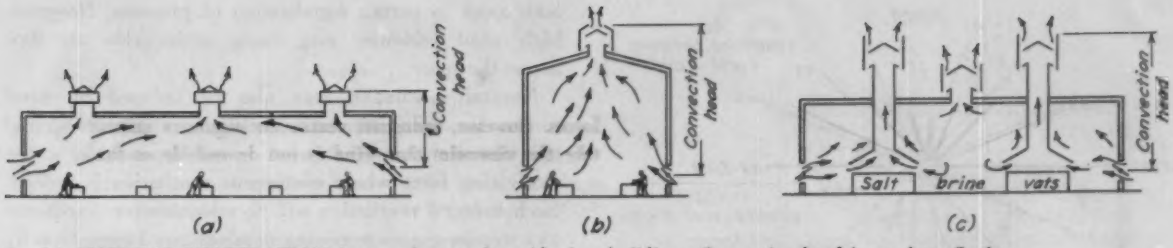
Q = air flow, cfm
A = free area of inlets and outlets (assumed equal), sq ft
h = height from inlets to outlets, ft (See Fig. 4)
t_i = *average* temperature of indoor air in height h, F
t_o = outdoor temperature, F
9.4 = constant of proportionality, including a value of 65 percent for effectiveness of openings. This should be reduced to 7.2 if conditions are not favorable.

The velocity through the ventilator openings will seldom exceed 500 fpm. Consequently, large ventilator area is required for adequate removal of the hot air within a building. The openings may cause structural and weather problems and may be expensive to provide. This will vary greatly with the type of construction and the degree to which it is necessary to maintain a weathertight building.

It must also be kept in mind that the inlet areas must be large, or the desired exhaust flow will not be obtained. They must be as low as practical in order to obtain the maximum convective head h.

The importance of adequately sized inlet and outlet openings cannot be overstressed. Prof. T. F. Hatch, Graduate School of Public Health, University of Pittsburgh, who has done considerable research on heat relief in hot areas, points out that, unless adequate exhaust openings are provided over hot operations, the high volume of primary and secondary (induced) air set in motion by the source of heat will not be permitted to leave the building directly. As shown in Fig. 2a, this will create a rotating air motion in the building which

The author is a member of the technical advisory committee on industrial environment of the American Society of Heating and Air-Conditioning Engineers. He has written several articles for Heating, Piping & Air Conditioning on the various aspects of operation and maintenance of heating, ventilating, and air conditioning equipment and systems in industrial plants.



1 (a) NATURAL VENTILATION is not adequate for wide, low buildings. Convection head is too low. Cooler periphery air will bypass center areas. (b) Natural ventilation is best applied to high narrow buildings having 30 to 60 ft convection head to provide adequate air movement. Narrow building provides better ventilation for center areas. (c) Exhaust canopies and stacks over salt brine vats provide good convection, can bring periphery air to all parts of space. Roof exhauster should be provided to remove hot air under ceiling

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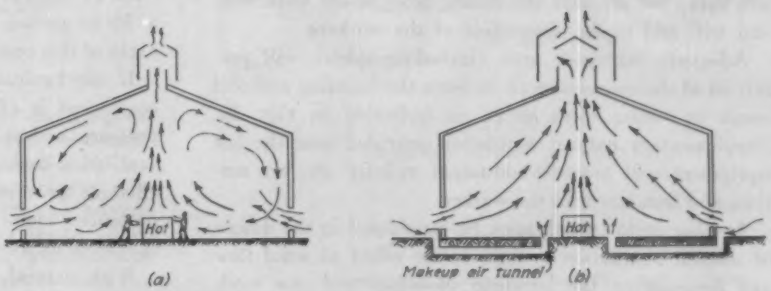
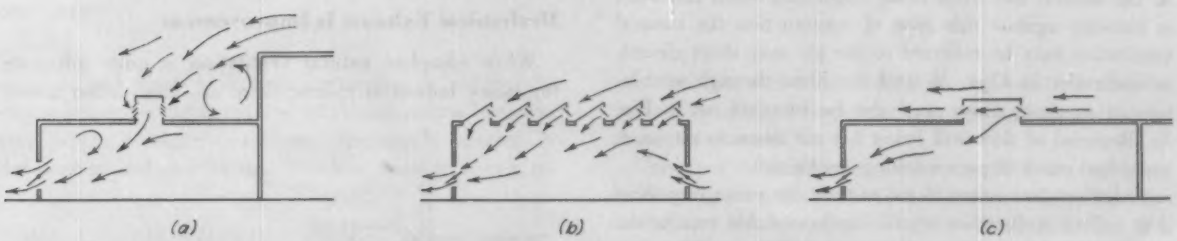
2 (a) WHERE EXHAUST VENTILATOR area is too small, convection forces from hot equipment in center create rotary movement of air and bring hot air from ceiling down to work area. (b) Area of exhaust ventilator must be large enough to permit discharge of primary and secondary (induced) air rising from hot equipment. This will prevent air rotation and make work zones cooler. Inlet areas must be adequate and low to permit convection ventilation. Bringing outside air near hot equipment will make area cooler and provide some heat relief





3 EXAMPLES OF FLOW REVERSAL with natural ventilation, resulting in hot ceiling air being blown down to work zones is shown here: (a) ventilator located in downdraft area, (b) wind blowing against saw tooth construction, and (c) wind both blowing down through building and short circuiting through monitor

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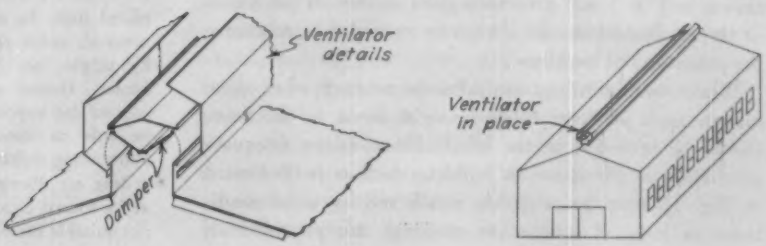
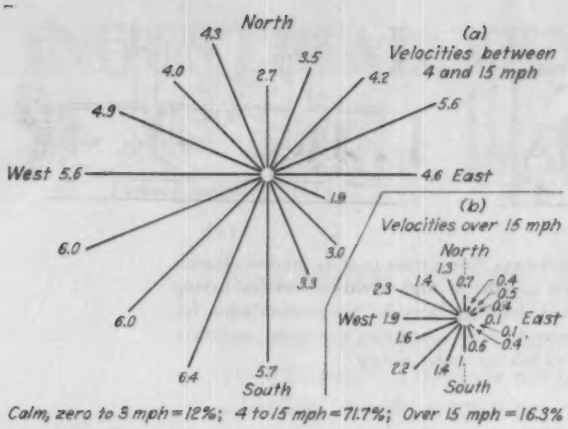
4 CONTINUOUS ROOF VENTILATOR is most suitable for moving large volumes of air where good convection force is available. Dampers should always be provided for shutoff. When installed as shown they reduce friction and increase air flow





5 WIND ROSES indicate durations of wind directions in percent for (a) winds between 4 and 15 mph; (b) over 15 mph

will bring hot air near the ceiling down to the work zone and will add to the discomfort of the workers.

Adequate ventilator area (including inlets) will permit all of the convection air to leave the building and will result in cooler work areas, as indicated in Fig. 2b. Supplementary natural ventilation provided near the hot equipment will provide additional makeup air, air motion, and heat relief for the worker.

Another factor which must be considered in the design of natural ventilation systems is the effect of wind flow and pressure on the building. Monitors and saw tooth construction have been provided for many buildings in the belief that they were desirable in providing good ventilation and could be oriented for the prevailing wind. Their use has created problems of solar heat load in the summer and high heat load, condensation, and infiltration in the winter. But even more important, when the wind is blowing against this type of construction the natural ventilation may be reversed or the air may short circuit, as indicated in Figs. 3b and 3c. Flow through ventilators in pressure zones may also be reversed, as in Fig. 3a. Reversal of flow will bring hot air down to the work zones and result in poor working conditions.

There are few areas, if any, where the prevailing wind is of sufficient duration to provide dependable ventilation. Nor would this justify orienting a building or its ventilators to suit this wind condition.

In designing the systems, the exhaust ventilators should be located outside of wind pressure zones if possible. Weather type ventilators, either round or continuous, should be provided. Where large volumes of air must be exhausted over large areas the continuous ventilator shown in Fig. 4 will give very good service. Wind bands or the equivalent should always be provided to minimize the possibility of backflow.

Where two buildings are adjacent to each other some means, such as large inlets brought down to the floor, should be provided on the blind side to assure adequate ventilation in the space. A building such as is illustrated in Fig. 1b may be relatively unaffected by wind conditions as long as infiltration openings are provided on both sides to permit equalization of pressure. However, high wind velocities may cause undesirable air flow across the space.

Natural ventilation may also be induced by wind forces. However, industrial ventilation engineers should take the viewpoint that wind is not dependable as the motivating force where continuous ventilation is needed. Such induced ventilation will be adequate for warehouse and storage spaces requiring nominal ventilation. Gravity roof ventilators should always be sized on the basis of convection capacity. Wind induced capacities, if realized, should be considered as an extra.

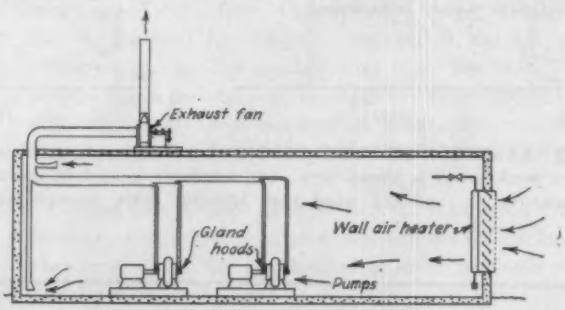
That wind cannot be relied upon for ventilation is well illustrated by Fig. 5. This chart indicates that the wind for Chicago is calm about 12 percent of the year. While a weakness is evident in the southeast quadrant, the other three quadrants are of about equal magnitude. It is obvious that there is no prevailing wind. Frequently the wind in Chicago will swing through a full 360 deg during a 24 hr period. Such a chart is typical of most of the areas of this country.

If mechanical exhaust for hoods, process, or other equipment is of sufficient volume to create a negative pressure within the building and offsets the convective ventilation forces, the natural "exhaust" may be made ineffective or reversed in flow. This is of particular importance where process or combustion equipment is operating on natural exhaust.

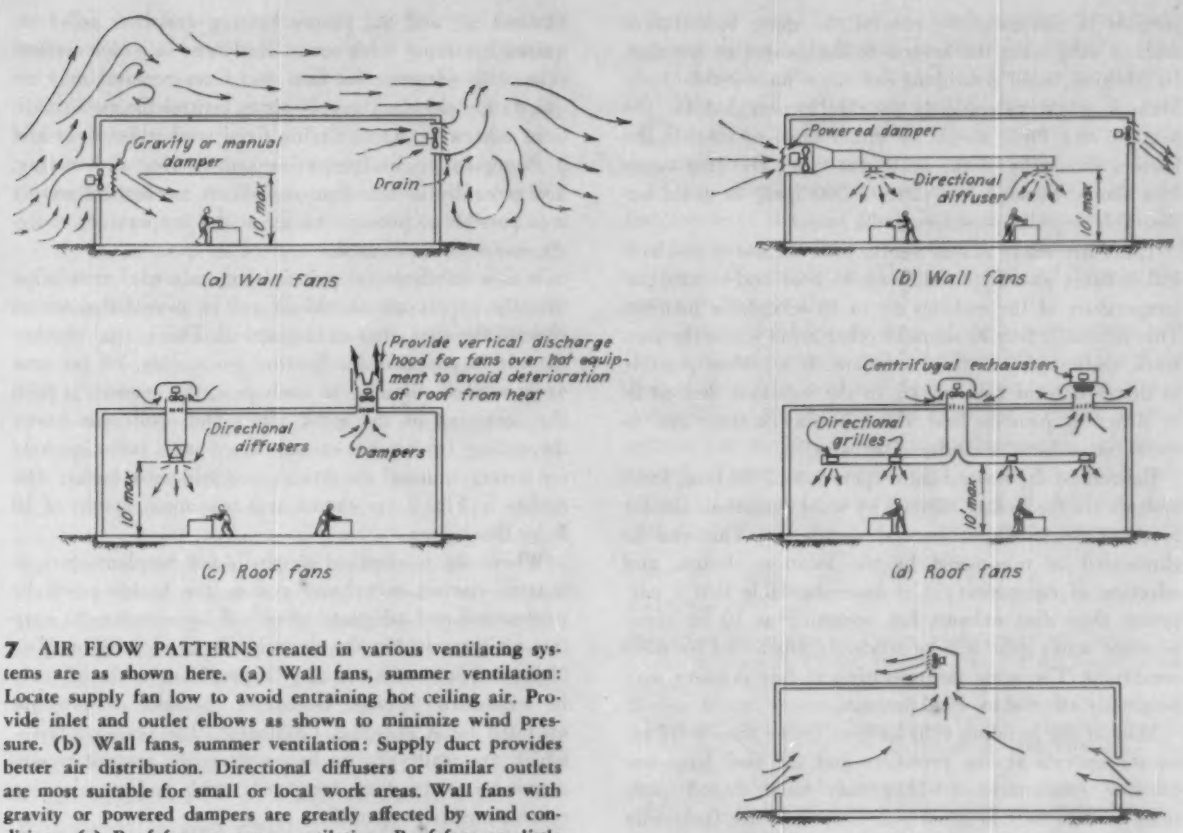
With natural supply and exhaust ventilation it is always a problem to temper the supply air in cold or cool climates. With so little convective force available it is seldom practical to lead the air through heaters. In some cases, as in boiler rooms, it is possible to lead air over the hot equipment in order to temper it.

Mechanical Exhaust Is Improvement

While complete natural ventilation is quite adequate for many industrial spaces, there are many other build-



6 MECHANICAL EXHAUST, tempered natural supply depicted here. In process areas and pump rooms requiring fume removal, room and equipment hood exhaust may be provided by single fan. Supply air may be drawn in through wall heater. Heater should be of antifreeze type with manual control for exposures to subfreezing air. Face velocities should be low to avoid excess negative pressure in space. Floor and ceiling exhaust is indicated for removal of fumes and hot ceiling air. Pump gland hoods are indicated for fume removal at its source. System is suitable for areas not normally occupied, not suitable for occupied spaces



7 AIR FLOW PATTERNS created in various ventilating systems are as shown here. (a) Wall fans, summer ventilation: Locate supply fan low to avoid entraining hot ceiling air. Provide inlet and outlet elbows as shown to minimize wind pressure. (b) Wall fans, summer ventilation: Supply duct provides better air distribution. Directional diffusers or similar outlets are most suitable for small or local work areas. Wall fans with gravity or powered dampers are greatly affected by wind conditions. (c) Roof fans, summer ventilation: Roof fans are little affected by wind conditions, are reliable and usually accessible for maintenance. These fans are becoming increasingly popular for supplementary ventilation. (d) Roof fans, summer ventilation: Supply duct installed for better distribution, with directional grilles to permit directing air up or down as desired. Directional grilles are better for large coverage and work areas. To be effective, outlets must be low. (e) Wall fans, penthouse type: Unit is considerably affected by wind conditions. Consequently, it is likely to be largely supplanted by roof type fans in new construction

ings — and these have been increasing in number in recent years — which require additional means to maintain proper working conditions. Mechanical exhaust is the next logical step in this direction because it can remove hot air and fumes which would accumulate under the ceilings of buildings which do not lend themselves to convection ventilation.

This type of ventilation is best applied in buildings needing supplementary exhaust, but where controlled conditions are not important. Plate fabricating, forge, and many mill operations having low worker population may be of this type. Mechanical exhaust is frequently provided in boiler houses or process areas by means of forced draft, process, or hood fans. In many such cases the air does not need to be tempered. Instead, it can be drawn in over the boilers or other hot equipment without passing across work areas, and can be heated acceptably for working requirements.

In pump rooms or process areas requiring fume removal, general ventilation, and heating for freeze protection of piping and equipment, the exhaust can be provided by a single fan and the makeup air can be drawn through a wall heater, as shown in Fig. 6. This system is suitable for spaces not normally occupied by personnel except for occasional rounds by the operators. It is not suitable for occupied spaces because it is not

TABLE 1 — AIR VELOCITY, equivalent velocity pressure, wind speed, equivalent wind pressure, force required to open door are compared

Velocity, fpm	Velocity pressure, in. WG	Wind velocity, mph	Equivalent wind pressure, psf	Force to open 80 × 30 in. door, lb
100	0.0006	1.14		
200	0.0025	2.28		
300	0.0056	3.42		
440	0.012	5.0	0.06	0.5
880	0.05	10.0	0.26	2.2
1000	0.06	11.4	0.3	2.6
1320	0.11	15.0	0.6	4.8
1760	0.19	20.0	1.0	8.3
2000	0.25	22.8	1.3	11
2640	0.43	30.0	2.2	19
3000	0.56	34.0	2.9	24
3520	0.77	40.0	4.0	33
4000	1.00	45.5	5.2	43
4400	1.20	50.0	6.2	52
5280	1.73	60.0	9.0	75
6000	2.25	68.0	11.7	97

$V = 4005\sqrt{b_v}$
$V = 88(\text{mph})$
$P_w = 5.2\ b_v$
$F_d = 8.33\ P_w$

V = air velocity, fpm
b_v = velocity pressure, in. WG
P_w = wind pressure, psf
F_d = force to open 80 × 30 in. door, lb.

possible to automatically control the space temperature without subjecting the heaters to the danger of freezing. In addition, wind conditions can cause undesirable draft. Manual steam valves *only* should be provided for the heaters, and these should be either open or closed. The heaters should be of the antifreeze type. The face velocities should be kept low (200 to 300 fpm) to avoid undesirable negative pressures in the spaces.

There are many places where, with the use of mechanical exhaust alone, it is difficult to heat and control the temperature of the makeup air in an acceptable manner. This is usually true in shops or other areas where the men work continuously in fixed locations. It is seldom possible to direct natural makeup air to the locations desired in in order to provide heat relief in the summer and to avoid uncomfortable drafts in the winter.

Because of the low pressure operation of the fans, these systems are frequently affected by wind conditions similar to those described for natural ventilation. This can be eliminated or minimized by the location, design, and selection of equipment. It is understandable that a carpenter shop dust exhaust fan operating at 10 in. static pressure water gage will be relatively unaffected by wind conditions. The same fan operating at free delivery may be greatly affected by wind pressure.

Most of the building exhaust fans (other than hood exhaust) operate at low pressures and the fans have low pressure characteristics. They may have shutoff pressures of 0.25 to 0.50 in. WG or lower and are frequently purchased for free delivery. Actually they should never be specified for operation at less than 0.10 in. WG.

Table 1 indicates that wind speeds of 10, 15, and 20 mph correspond to velocity (impact) pressures of 0.05, 0.11, and 0.19 in. WG. From this and Fig. 5 it is evident that the air delivery of a low pressure wall fan discharging into the wind, as illustrated in Figs. 7b and 7e, may be cut drastically or stopped entirely (which is not uncommon) when opposed by the wind, and may operate at or near free delivery when assisted by the wind (in a negative pressure zone on the lee side of building). Such operation does not result in dependable or satisfactory ventilation for essential makeup systems. This undesirable characteristic of wall exhaust fans can be minimized by providing a discharge elbow, as shown in Fig. 7a. Wherever possible, the better solution is to provide roof type fans, because it is not possible to orient fans for prevailing winds.

Roof type exhaust fans provided with mushroom or upblast weather enclosures are relatively unaffected by wind conditions. These have increased tremendously in use in recent years because of this and the fact that wall fans fail to remove interior heat and fumes in wide buildings.

Supply Supplementary Air Mechanically

While mechanical exhaust is quite desirable in many cases to remove hot air and general building fumes, it is incapable of providing the directionalizing of the infiltrated air and the proper heating and heat relief required for many work areas. Buildings in which natural exhaust is adequate for heat and fume removal may require supplementary supply air to control the area conditions otherwise. Areas having fixed worker locations and high population, and requiring spot heating and cooling, are generally in this category. With mechanical supply it is possible to provide the air at the temperature, velocity, and location desired.

It is a fundamental principle of industrial ventilation that the supply air should always be provided down as close to the work zone as is practical. This is true whether the air is supplied for heating or cooling, or for spot or general ventilation. In each case, the concern is with the condition of the work zone. The conditions under the ceiling (unless hot enough to create a radiation load — a very unusual condition) are seldom a factor. The outlets in Fig. 7 are shown at a maximum height of 10 ft for this reason.

Where the mechanical supply is not supplementary to a large convection exhaust system, the building will be pressurized and adequate relief will be necessary to keep this pressure within the desirable limit of 0.05 in. WG. Natural type ventilators may be provided, or the air may be exhausted through motorized, manual, or pressure operated relief openings (dampers). The pressure types, which are really gravity louver dampers, are not recommended because they frequently stick and require too much pressure to open them.

Mechanical supply should never be used for dilution ventilation in conjunction with natural exhaust because this will cause contamination of adjacent areas.

Mechanical Supply-Exhaust Is Most Effective

It is evident that natural ventilation, mechanical exhaust, or mechanical supply have a place in many industrial applications. But for the great majority of new plants — which are acres in size, have low construction, high power and light loads, and high worker populations — there can be no question that the balanced, mechanical supply and exhaust system is the most effective in the control of the space conditions. The supply system can deliver the air where and how it is wanted. The exhaust system can effectively and dependably remove fumes and control the accumulation of hot air. Their combined operation can be adjusted to provide the desired inflow or outflow to adjacent areas as necessary to control space conditions.

In addition the supply inlets and the exhaust outlets can be provided in locations which will minimize the re-entry of fumes into the building, or the entry of fumes or dust from nearby sources. Mechanical elimination can also be provided.

In most cases these systems will include all of the ventilation in the building. In others in which there is adequate motivation to permit natural ventilation to provide the main ventilation, mechanical supply and exhaust sys-

tems can be provided to maintain the building balance and provide the local requirements for heating, heat relief, and fume removal. In addition these systems may provide supplementary summer ventilation by three different methods:

1) By the use of two-speed fans the supply system can be operated at maximum volume in the summer for heat relief and reduced in the winter to maintain the required volume for makeup air for process and hoods. This method is simple to operate but is expensive in first cost and operation because the fan motor and equipment must be sized for the maximum volume. Also, the two-speed motor is about twice the cost of a single-speed motor.

2) During the winter the air supply system may operate on recirculation, supplying the amount of outside air required for the hood or process makeup. In the summer the system would operate at the same capacity but with 100 percent outside air. This system, like (1) is simple to control and operate but is expensive in first cost and operation because the equipment must still be sized for the maximum condition. But the single-speed motor for this system would be much less expensive. This system has an advantage in that the circulation rate is constant. This usually will result in better performance of the filters, air heaters, fans, and outlets.

3) Supplementary roof exhaust fans may be provided for summer operation. The makeup air for these fans can be provided either by peripheral ventilation (open doors or windows) or, more effectively, by the roof supply fans indicated in Figs. 7c and 7d. Such supplementary summer ventilation aids greatly in removing building heat, thus permitting the main supply systems to do a better job. Power and equipmentwise this system is the least expensive, particularly where the summer air supply is considerably increased over winter conditions. However, the distribution system must be kept within the limitations of the roof fans. These are generally of the low pressure type. Because of this it is seldom practical to temper the supply air. This limits the usefulness of the system in cool weather.

The steam load for all three of the above systems will be at a minimum for winter operation. Which of the three designs should be used will depend upon power costs and the need for distribution and tempered air. The central systems are preferred where a continuous air volume is needed. Where the internal air is in an acceptable condition, the recirculation system would be the first choice. ‡

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THE LAW AND YOUR PROFITS

Contract Must Protect Against Loss

BY WILLIAM HURD HILLYER

IN THESE DAYS when numerous Federal, state, and municipal projects are contemplated, the engineer can, if he is not careful, encounter money and time loss perils, as is illustrated by the following case:

The city of Aquaville planned to expand its existing district heating system. An ordinance was passed accordingly. The city retained N.G. Nehr as consulting engineer.

A contract was entered into by both parties which, in substance, provided that Nehr was to be paid for his services out of a special fund to be derived from the sale of revenue bonds. He was to be paid on a percentage basis figured upon the total cost of the completed project. Payment was to become due in specified percentage steps as the work progressed. When bonds were issued to finance the project, fees based upon 60 percent of its completed cost would become due and payable.

If bonds were not issued the engineer would, nevertheless, be paid his fee. This was to be based upon his current progress estimate, up to 60 percent of completed cost, but reduced by 50 percent payment deferred without interest.

Nehr figured that such an estimate would show the engineering work 65 percent completed. All of it, together with appurtenant data and 10 sets of plans, was to be turned over to the city and become its property. In any event, Nehr was to be paid, subject to the 50 percent reduction, within three years after approval.

This contract appeared to give Nehr ample protection. Actually, it

(Continued on page 233)

WILLIAM HURD HILLYER, *author of this regular feature, is a contributor to a number of banking and financial publications and has written several books on business. He has an extensive practical legal and financial background.*

This series presents actual cases. All names are fictitious. It should be remembered that laws vary in different states.

Prison's Heating, Ventilating Systems

Requirements were that boiler room be remote from security area, that heating and ventilating equipment be protected from malicious damage.

BY JOHN H. ROSS
Professional Engineer
John H. Ross and Assocs., Ltd.
Consulting Engineers

A NEW APPROACH to the construction of penal institutions is evidenced in a new maximum security reformatory recently completed at Millbrook, Ontario, Canada.

A first glance at the architect's sketch shows the structure to follow the usual "telegraph pole" design in that the main part of the building consists of a central core with cell block wings at right angles to this section. The whole area is surrounded by a high wall. From this point on, similarity to conventional design ceases. There are many points in the construction of this prison that are believed to be unique in penal institution design.

The exterior bars on windows in the security area which have been the trademark of penal institutions for centuries have been eliminated. In their place, windows of clear glass block have been provided. Security has been maintained by the use of flat steel bars embedded and hidden in the mortar joints of the glass block.

Boiler Room Beyond Wall

Usually, institutions of this type have their boiler rooms located in security areas for operation by inmates. At Millbrook, however, the boiler room is located outside the security wall so that in case of riot it is not possible for the rioters to seize this nerve center and disrupt the remainder of the institution.

This room contains three 150 hp boilers of the package unit type. These operate at 10 to 12 psi and use No. 6 oil. Provision has been made for one future boiler to provide for an extension of the main building.

The boilers were purposely selected for low pressure in order to simplify the requirements for operating personnel. However, a small amount of high pressure steam is used in the laundry and dry cleaning area and this is supplied by a small automatic electric boiler. The auxiliary equipment in the boiler room is of the conventional type. An elevated engineer's office gives excellent supervision.

Pipe Steam Underground

Duplicate steam mains pass through one wall of the boiler room (actually a section of the security wall) and are carried underground in insulated conduit under the prison yard to a point where they enter the tunnel which runs under the main corridor. This eliminates any possibility of an escape path through a continuous tunnel to the boiler room.

Attached to the boiler room and outside the security wall are the warehouse and garage. All supplies for the institution are received at this point and a certain amount of meat processing is carried out before the supplies are taken through a sally port to enter the security area. This section is heated by means of steam unit heaters and some convectors. Ventilation is limited to small units to take care of local problems.

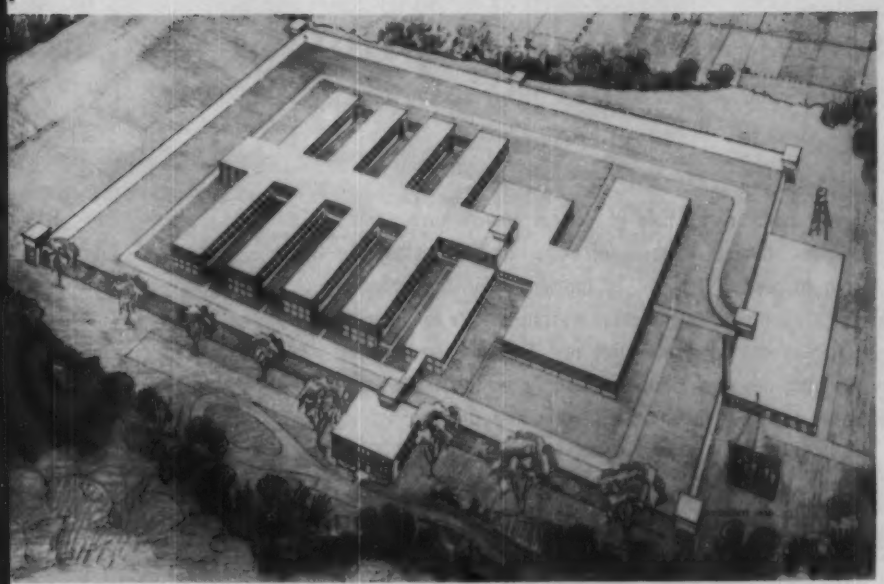
The administration building is also located outside the security wall. It is a typical two-story office building with additional facilities for supervising visits. Heating is supplied by baseboard radiation and convectors, and ventilation is limited to some independent exhaust systems.

Guard towers are located at strategic points. Those attached to the main building are heated with baseboard radiation around their entire perimeters to take care of the excessive heat loss caused by the great expanse of glass. Towers that are located along the security wall are heated by means of electric unit heaters mounted on the lower wall.

Security vs Ventilation

Since the cell block area would have no windows it was apparent early in the design stage that ventila-

Meet Maximum Security Needs



NEW REFORMATORY, as depicted in architect's sketch, is unique in design since boiler room, administration building are located outside security wall. Low pressure steam is piped to interior building via underground steam mains

tion would be of prime importance. While each cell had to receive its correct amount of air, precautions had to be taken to insure that the ductwork could not be used by inmates as speaking tubes.

In addition, heat had to be provided in cells. Exposed radiation in a security area has always suffered abuse during riots in these institutions, and exposed piping of any nature is a target for malicious damage.

With these and other factors in view, it was decided to install radiant heating in the floor slab of each of the cell blocks with additional piping in the ceiling of the second floor to take care of 70 percent of the heat loss. This portion of the heating is controlled by an outdoor thermostat.

The additional 30 percent of the heat loss, the ventilation, and the final control of air temperatures is provided by an air handling unit for each cell block wing. This unit also incorporates an exhaust fan and additional dampers so that the guard on duty may switch this unit over to 100 percent exhaust if required.

The supply air ducts are carried through a small trench below the ground floor and vertical risers are carried from this main independently to each cell. This eliminates any direct connection in ductwork from one cell to another. The same fundamental design is carried through the hospital wing, reception wing, and chapel. The shops and kitchen have unit heaters with conventional ventilation at specific points.

Protect Controls, Diffusers

Thermostatic controls are of the pneumatic type throughout, with modifications designed to suit the building. To prevent tampering it was necessary to recess the thermostats in steel boxes in the ceilings of certain cells. At the same time the boxes had to be so arranged that they would not serve as hiding places for small articles.

The diffusers for the cells presented the same problem. This was solved by the development of a special model for this purpose. Covers for both these units consist of steel plates with a number of small holes. When the holes in the diffusers were made small enough to satisfy security requirements, invariably the diffusers were far too noisy when handling the required cfm of air. Countersinking finally solved this problem.

While space has been left in all units for future cooling, if required, the only cooling installed at this time is in the operating room of the hospital wing. Humidification is also provided in this area.

The present facilities are designed to accommodate 200 inmates. Allowance has been made for a future extension which will increase this number to 300. The complete project was built at a cost of about $2½ million.

Barnett & Rieder were the architects. The mechanical (heating, piping, and air conditioning) contractor was Harold R. Stark, Ltd. ÷

What Can Be Done to Combat Failures in Nuclear Piping?

The strides being made in the field of nuclear energy have made imperative the need for standard methods of inspection and testing of nuclear power piping to prevent failures. In the May issue the authors cited the differences between nuclear and other pressure service conditions, broke down reactor piping into three categories, and discussed some of the inspection techniques that are used. This article continues this discussion, and relates the causes and cures for thermal failures in nuclear piping.

BY V. T. MALCOLM
Engineering Consultant

and

SIDNEY LOW
Director of Research
Chapman Valve Mfg. Co.

THE CLASSIC TEST for proving both the pressure tightness and strength of piping system components is still the hydrostatic test of ambient room temperature. General production tests utilize water — with or without emulsifiable oil additions — or kerosene as the test medium. These same media can be used for some nuclear applications if subsequent cleaning will satisfy the cleanliness requirements.

Since it is generally impossible to properly clean after hydrostatic testing, most such tests are performed on hot and/or cold clean loops. The majority of loops of this type operate on pure water. In order to maintain loop water purity the loops are usually constructed of austenitic stainless steel with purification devices incorporated into the loop. Mixed bed resin type demineralizers are commonly used for water purification.

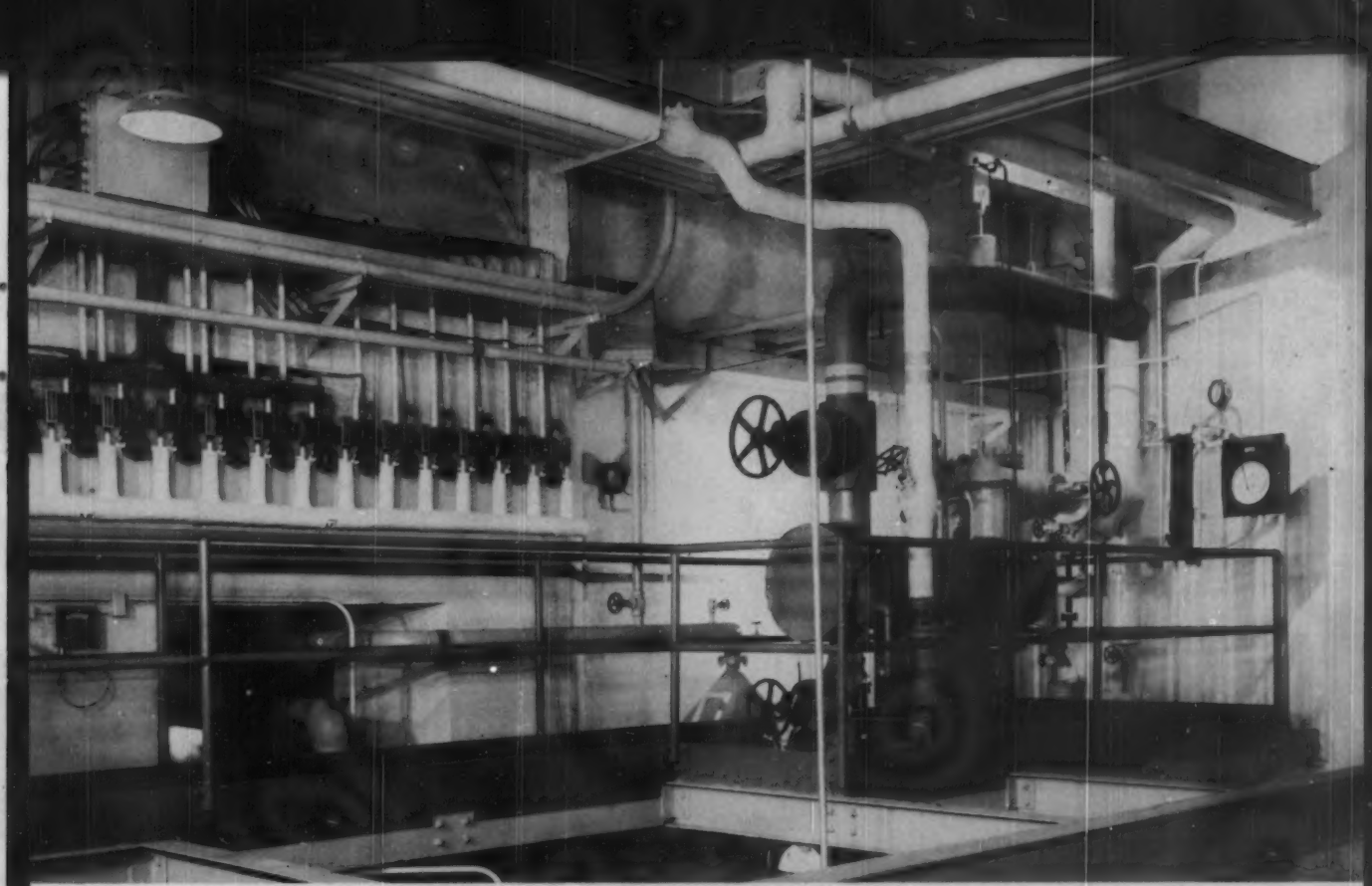
The detection of leaks during hydrostatic tests is usually visual, with or without an observed drop in the system pressure. Visual observation of a very minor leak is often difficult when testing with water at ambient room temperature. To aid in detecting these minor leaks, some specifications require that the system under test be held at pressure for several hours. The time at pressure is usually a function of the thickness of the pressure containing shell. An observed drop in pressure in a closed system under hydrostatic test is also an indication of a minor leak, although the leak location is unknown.

Pressure testing, using air, nitrogen, helium, or other gases as pressurizing media, is extremely sensitive and will usually detect the smallest leak. The use of helium gas (or a mixture of helium and another gas) as the pressurizing medium, coupled with the use of a mass spectrometer type of leak detector will permit minute leaks at atmospheric pressure to be detected.

Many current pressure test specifications are written about the use of a mass spectrometer type of leak detector. In general the envelope methods are capable of testing the overall tightness of a vessel or system. The actual leak location must be determined by means of a probe method of test. The probe method will usually locate a leak within 1/8 in.

A similar but less sensitive test employs a halogen vapor type of leak detector. The system or vessel under test is filled with either refrigerant No. 12, gas or air with refrigerant No. 12, or carbon tetrachloride added. A leakage rate of 1/100 oz of refrigerant per year can be detected. A leakage rate of 1 oz of refrigerant

This article is abstracted from a paper presented at the 1958 Nuclear Congress held recently in Chicago.



NUCLEAR PIPING, such as is installed at Argonne National Laboratory, must be carefully inspected and tested to meet rugged operating conditions. Standardization of testing procedures will aid in development of code for design, installation, inspection of such piping to assure safe operation. Shown above in inside view of experimental boiling water reactor at Argonne

per year can be detected using 1 oz of same per 30 cu ft of system volume.

If it is suspected that a system or vessel contains rather large leaks, it is often practical first to run a halogen vapor type of test to detect the gross leaks, make indicated repairs, check repairs with halogen vapor, and, if satisfactory, proceed with mass spectrometer test. Liquid soap coupled with air pressure is still an excellent method of locating gross leaks in a system and is often the most sensible first gas pressure test following hydrostatic testing.

Closing of Openings Presents Problems

The closing of various openings during hydrostatic testing often presents many problems. This is particularly true of welding ends on piping components that require temporary mechanical sealing. Many ingenious sealing members have been designed to temporarily close welding ends. All metal closures utilizing self-sealing principles can be utilized at temperatures to approximately 1000 F. Self-sealing types of closures using nonmetallic sealing members constructed of asbestos, plastic, or similar materials are limited to the maximum temperature permitted by the nonmetallic member.

There are several methods currently in use for computing the maximum room temperature hydrostatic testing pressure.

Once the pressure tightness and strength of the piping system components are proven, functional members such as pumps and valves are subjected to operational tests. The first units should be carefully evaluated by means of engineering or lead unit tests. These lead unit tests usually consist of cyclic and/or continuous operation under design or overload conditions in order to detect deficiencies in design, materials, or workmanship. Members subject to extreme wear such as valve seats or pump bearings must be carefully inspected before and after testing to ascertain wear rates.

The internal and external surface finish requirements of piping system components have been a controversial subject. Rigid specifications requiring nonfunctional surfaces to have a maximum roughness of 125 micro-inch, irrespective of waviness, have proven costly and have resulted in extended delivery promises.

Piping system components intended for nuclear service are usually subject to rigorous cleanliness requirements. In general, the cleanliness requirements are not unlike specifications used many years by the chemical industry.

Combat Thermal Shock, Fatigue

Serious problems that are encountered in the construction of nuclear power piping systems are thermal shock and thermal fatigue.

The differences between the two are primarily related

to the rate of cooling and the temperature cycle. When a number of thermal cycles are the major cause of failure, the condition is termed thermal fatigue. However, when the force of the cycle is primarily responsible, failures are denoted as thermal shock.

The problem of thermal shock, either instantaneous or cyclic, has caused much discussion among engineers engaged in the design of piping systems. While much progress has been made in this field, the solutions to all problems are not yet available. This is especially true for nuclear power installations, because the conversion of nuclear to thermal energy in these systems is very realistic and results from thermal fluxes many times those encountered in the heat transfer systems of conventional steam plants.

In steam station piping a slug of cold water may pass through the system causing shock, but in nuclear systems, especially when molten metals are used as the heat transfer fluid, rapid temperature changes may be caused by sudden loss of either heating or cooling. This often results in stresses greater than the yield strength of the metal. These high stresses under thermal shock are inherent due to the relatively low thermal resistance of the interface of molten metals and the pipe wall.

During rapid temperature changes the stress patterns are set up in three directions: radially from the center, tangentially, and longitudinally along the pipe wall. The tangential and longitudinal stresses reach maximum values at the inner and outer fibers of the pipe wall, and radial stress attains maximum values at the center of the pipe wall.

Austenitic chromium nickel stainless steel is generally used for nuclear power piping and components. This material has the unusual property of incorporating a high thermal coefficient of expansion with a low thermal conductivity. For the same heat transferred, much higher thermal stresses can result than for carbon or low alloy steels.

As a rule the designer can calculate thermal stresses which are induced by differential expansion in a statically indeterminant system. The difficulty arises when thermal effects are cyclic in nature, for here stresses are first elastic, and then become plastic from severe thermal effects. When the thermal load is removed, the stresses are first reduced elastically, but if high stresses have been set up causing plastic deformation, complete thermal unloading will cause the stresses to reverse their direction. This often causes a reversal of plastic flow. Subsequently, unstable plastic flow predicts fracture.

When rapid cooling is originated inside of the pipe wall, the area from the inner fibers of the wall outwardly to the mean temperature of the wall is considered to be in tension. The remainder of the pipe wall is in compression because cooling in this sector lagged due to thermal resistance of the metal. The forces in tension occurring on the inner part of the wall are much greater than the compressive forces acting on the outer sector of the wall. In austenitic stainless steel the stresses in tension (sudden shock) at 1½ sec are more than double the yield strength of the metal and greater than the tensile strength. Even though they are dissipated to below the yield strength in 8 sec, the pipe and components have not been found to be damaged.

Thermal Failures Cause "Notches" in Piping

Thermal shock and thermal fatigue failures usually involve crack formation and crack propagation. These formations may be microcracks brought about by "notches," of which there are two types. One notch type is metallurgical and the other mechanical. They can exist separately or together.

Metallurgical notches are obtained from inclusions in the pipe or welds caused by oxides and slag entrainment. However, they are not so prevalent as mechanical notches resulting from sharp corners, re-entrant angles, poor fit-up, changes in section without proper fillets, incomplete welds, crevices, underbead cracking, hot tears or microfissure due to improper or poor welding techniques, or to anything that will disturb the uniform flow of stresses or that cause the strength of the metal to be exceeded.

Most of the chromium nickel austenitic stainless steels used for nuclear power piping originally are not notch sensitive and, when an excessive load is applied, lateral contraction results with an apparent reduction of stress.

If steels are made notch sensitive by microcracks, tears, forging bursts, or inclusions in the weld, they become extremely notch sensitive, especially if the steel is coarse grained due to low hot ductility.

In the case of notches the stress is not transmitted across the notch so there is no tendency for the metal on either side of the notch to elongate. Hence, it does not contract laterally. When a severe condition of shock exists imposing multiaxial stress, the steel will tear at the root of the notch without plastic flow and failure will result.

Inspection must be very carefully made to be sure that notches do not occur in the welds of the pipe.

Where the sum of the pressure and thermal stresses cannot be kept within the yield strength of the metal, ductility must be depended upon to relieve the peak stresses. During fabrication a condition exists in most welds of austenitic stainless steels where weld shrinkage produces residual stress considerably in excess of the yield strength but is relieved by plastic flow. Therefore, ductility plays not only an initial but a continuous role in performance, minimizing the effect of notches and flaws that may occur during root pass weld techniques.

In the next article on this subject of nuclear piping, the authors will discuss welding fabrication techniques for heavy walled piping. ≠

Design New Hospital Heating, Air Conditioning for Expansion

Built-up mechanical systems serving the new Asbury Methodist Hospital were designed so that the building can be air conditioned almost throughout just by adding cooling coils in the supply air units and increasing equipment capacity. With an eye toward the possible future addition of two floors, piping services are extended to the underside of the roof. Space for an additional boiler to heat these floors is set aside in the central equipment room. Only critical areas are air conditioned now. Prechilled well water is the cooling medium.

BY WILLIAM STURM
Ellerbe and Co.
Architects and Engineers

THE NEW Asbury Methodist Hospital in St. Louis Park, Minn., a suburb of Minneapolis, personifies good heating, ventilating, and air conditioning design. The systems are engineered to fulfill the present requirements of the institution and also to permit future mechanical expansion with a minimum of time and trouble.

The almost completed structure, comprising a ground floor and six floors above, has an area of 208,250 sq ft excluding the penthouse. The plan is a cross type, with the fourth to the sixth floors consisting mainly of patient rooms and lower floors occupied by the remaining hospital functions. These lower floors deviate from the cross plan, with two corners of the cross filled for additional area.

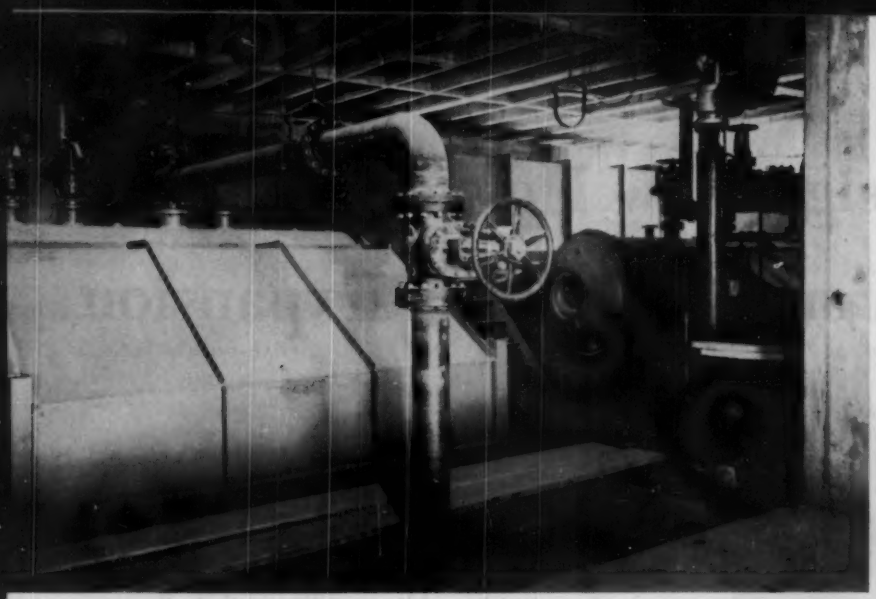
The two-story boiler room is adjacent to the hospital.

All mechanical equipment is in two major equipment room areas. This feature, coupled with the fact that all equipment is spotted with adequate clearance, facilitates excellent continuous supervision of all equipment. Repair and maintenance is also simplified by this planning and results in a minimum of disturbance to the occupied areas.

Mechanical equipment areas consist of the boiler room—which houses the boilers, auxiliaries, refrigeration equipment, air conditioning equipment, circulating pumps, water treatment equipment, heat exchangers, central system air handling units, incinerator, and the engineer's office—and an equipment room in the basement directly opposite the boiler room across the building which contains additional central system air handling units. The only equipment for heating, ventilating, or air conditioning not contained in these two areas are exhaust roof ventilators and laboratory exhausts.

Consider Future Conditions

Three future conditions were considered in the mechanical planning. While air conditioning is confined to certain critical areas at present, it was decided to provide for complete air conditioning in the future. This may be done by adding cooling coils in the main air supply units and by increasing the equipment capacity. Additional pipe runs are installed against the possible addition to two floors. Piping for these additional floors is extended to the underside of the roof for extension to a new pent-



MECHANICAL EQUIPMENT is located in two major equipment room areas. Feature facilitates continuous supervision, simplifies repair and maintenance. Interior of two-story boiler room, which is adjacent to hospital, is shown during equipment installation at left

house equipment room. Piping for a future laundry area is also installed.

Choose Central System Design

The structure is mechanically ventilated throughout. Some spaces are air conditioned year' round and all other areas, except mechanical equipment and laundry, are designed for future year 'round air conditioning.

All ventilation and/or air conditioning systems are of central system design, with automatically controlled hot water reheat coils for each individual room. Central systems are used because they have the following inherent characteristics:

1) Low initial cost
2) Low operating cost
3) Ease of operation
4) Simplified maintenance requirements
5) Consistent control of relative humidities for all spaces and zones
6) Low noise level
7) Economical satisfaction of ventilation requirements which, in numerous locations throughout a hospital, are in excess of heat gain requirements.

The central air handling units supplying areas not air conditioned need only have cooling coils and cooling coil control installed to provide air conditioning. Individual rooms, air conditioned or not, have identical air distribution outlets and space temperature control.

The staff meeting room in the basement, the kitchen, cafeteria, and emergency areas of the first floor, all of the second floor comprised of operating, x-ray, central supply, and laboratory areas, and the obstetrics section of third floor are all air conditioned. The non-air conditioned areas include the administrative and business offices, nursing work areas, and patient rooms.

Nine central air handling units supply air to the building. Each of these units is built up on the job with adequate space and lighting between unit components for walk-in access. Unit breakdown is based on the function of the area being supplied, its period of operation, and the physical limitations of unit size. Exhaust fans are set up to parallel supply units so that areas of less than 24 hr operation may be shut off without air unbalance in the building.

In a few instances, overlapping of exhaust areas was excessive when the area supply was shut down. Consequently, these exhaust branches are equipped with motorized dampers which are interlocked with the supply fan to the area in such a way that they would close to avoid area unbalance. Simultaneous action by inlet dampers or speed reduction reduces the total exhaust fan capacity.

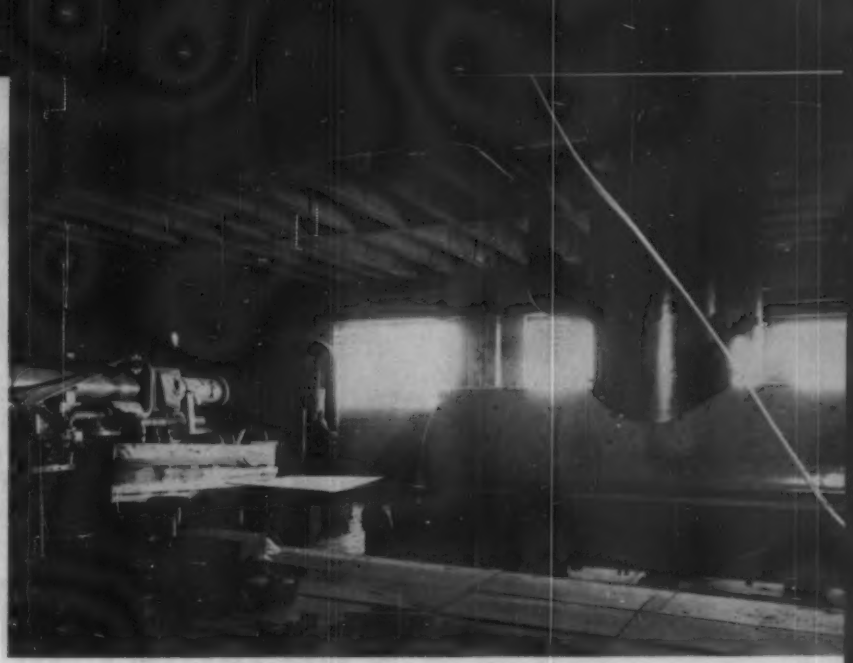
Dry type automatic filters are provided for all units and the operating room unit, and the recovery and obstetric units have dry type automatic prefilters and dry type electronic afterfilters. All units have steam distributing preheat coils.

To prevent freeze-up and to facilitate satisfactory control, units circulating 100 percent outdoor air have two one-row preheat coils with row control by steam valves which are operated with outside temperature and final temperature control by face and bypass dampers. Units mixing return air and outdoor air have one-row preheat coils with motorized steam valves. Each valve is controlled by a thermostat located in the leaving air stream.

Chilled water cooling coils are of serpentine type, and are eight rows deep. A motorized valve throttles the chilled water flow in response to the thermostat setting. Humidifiers located at the main air handling units are the direct steam-to-air type. Additional humidity required by certain scattered rooms is supplied by steam pan type humidifiers attached to the ducts serving these rooms.

Orifices Prevent Unbalance

Ducts are of the conventional type used for low pressure systems. The use of orifice plates at branch takeoffs to individual rooms is an unusual addition to the conventional



UPPER LEVEL of boiler room houses feedwater heater, right, and chiller, left. Other equipment located in structure includes boilers, auxiliaries, air conditioning equipment, circulating pumps, water treatment equipment, heat exchangers, air handling units, engineer's office

layout. This scheme of providing built-in balance to the system was devised to eliminate the one serious objection to low velocity systems in large buildings. Experience has shown that the use of these orifice plates has effectively checked unbalance in trunk ducts caused by duct resistance and building stack effect.

The orifice requires no splitter nor branch dampers concealed in ceiling spaces. With plate resistances properly calculated, pressure variance between the first and last diffuser is slight and can be adjusted at the diffuser damper.

Well Water Is Cooling Medium

Prechilled well water is the cooling medium. The main components of the system are a deep well, deep well pump, well water surge tank, well water circulating pumps, a reciprocating electric drive packaged water chiller, and central air handling unit cooling coils.

Water is pumped from the deep well at about 52 F and is circulated through the chiller where it reaches 42 F at the outlet. This water is piped to the individual central unit coils where its temperature rises to 64 F on leaving the cooling coil at design conditions.

From these coils the piping is extended to the condenser. Control of flow at the condenser acts automatically on condensing pressure. From the condenser the water is discharged to the storm sewer or through the lawn sprinkling system.

The deep well is drilled and the well water piping is sized for future air conditioning of the entire structure. Piping is extended to the location of future cooling coils at the central air handling units. It is also extended vertically to serve future air conditioning equipment in a roof penthouse for the seventh and eighth floors.

The water chiller is on the upper level of the major equipment area, with the location and structural framing set up for complete flexibility in the selection of future water chilling machinery.

Heat by Hot Water, Steam

Heating is primarily by hot water, with steam fed unit heaters used at entrances. Two separate water systems are used, each having standby capacity through the use of multiple pumps and shell-and-tube convertors. All heat transfer and circulating equipment is in the boiler room. Expansion tanks are in the penthouse.

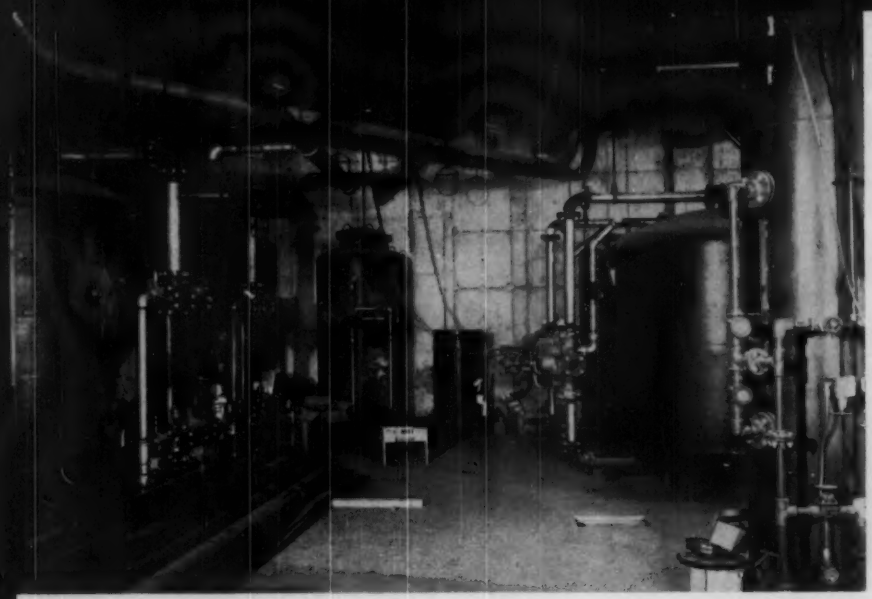
The lower level radiation system heats the perimeter of the first and second floors and that part of the perimeter of the ground floor which is above grade. Virtually all of the rooms in the perimeter are supplied air through individual reheat coils which are controlled by individual room thermostats.

The function of the radiation system is to offset the transmission loss, with the room air temperature being controlled by supply air. To perform this function the radiation system supply temperature is varied by automatic reset with outside temperature. Fin tube radiation is used in most areas, while convectors are used in others.

All reheat coils, located from the ground floor to the sixth floor, and low pressure induction unit coils, on the third floor and up, are supplied by one set of pumps and convertors. This is termed the "reheat system." Its purpose is to provide a constant water supply temperature. All reheat coil and induction unit coil water quantities are controlled by motorized valves operated by room thermostats. The primary air temperature to the induction units is varied and reset upward as the outside temperature drops so that, at −20 F, the air supplied to the unit is 75 F. With this operation, the capacity required of the water system by the induction units is considerably less than if capacity for both transmission and maximum reheat were required at the unit simultaneously.

Boilers Use Gas, Oil

Two 23,000 lb per hr boilers are installed. Space is provided for



WATER TREATMENT for various hospital needs is critical. Equipment includes iron removal filter for cold water, sodium zeolite softeners for hot water, dealkalizer for boiler feedwater treatment, deionizer for distiller and special laboratory supply

future installation of a third unit of the same size.

Boilers are water tube, cross drum type with pressurized furnace designed for 160 psig. Firing equipment consists of packaged mechanical, steam atomized, forced draft combination burners with gas as the base fuel and No. 4 oil used as a standby. Combustion controls are pneumatically operated and automatically proportion fuel and air flow in direct ratio to steam demand.

Each boiler has a panel for mounting gages, flow meters, CO_2 recorders, and various control and safety equipment. Boiler auxiliaries include feed pumps, condensate transfer pumps, condensate storage tank, deaerating heater, fuel oil pumps, and fuel oil storage tank. Feedwater regulators are of the two-element type which maintain feedwater flow equal to steam flow throughout the operating range of the boilers.

Supply Domestic Hot Water

All domestic hot water services originate in the boiler room. Various services meet the special requirements of operating rooms, laboratories, patient rooms, and kitchen.

All water to the building is pumped to assure uniform pressure due to the variation of the pressure of the utility main. It is treated according to its use. Treatment equipment consists of an iron removal filter for general cold water service, sodium zeolite softeners for hot water, a dealkalizer for boiler feedwater treatment, and a deionizer for distiller and special laboratory supply.

Hot water is supplied at zero hardness for kitchen use and softened cold water is blended with hard cold water through a proportioning valve to result in 5 grain hardness hot water for general usage. Softeners are of the fully automatic regeneration type.

All patient rooms are piped for oxygen and vacuum outlets.

Control from Central Panel

A control panel in the engineer's office in the boiler room provides a central location for warning devices, pressure and temperature gages for various services, fan and pump controls and a temperature indicator and recorder.

Warning devices consist of lights providing high and low level indications for various tanks such as domestic water surge, well water surge, and fire protection system hydropneumatic.

Pressure gages are provided for domestic water, fire protection, compressed air, gas, and vacuum indications. Dial thermometers are installed for hot water services.

All ventilation and air conditioning fans and heating pumps are controlled from the panel. All have push-buttons and pilot lights except where interlocking is used, as with the control of a second fan. In this case a pilot light is used to indicate operation of the interlocked device.

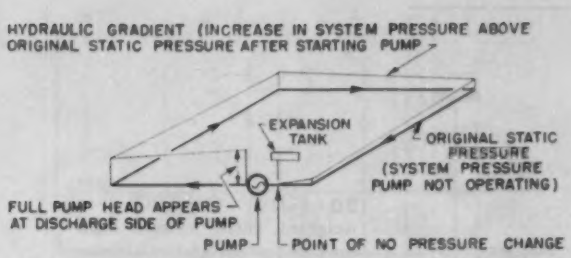
Temperature indicating and recording of 48 points throughout the building is available through an electronic temperature indicator, a transfer plug apparatus, a key switch assembly, and an electronic temperature recorder.

By use of the key switch and temperature indicator any one of the points can be read individually. Through the transfer plug and temperature recorder, any eight points of the 48 can be simultaneously and continuously recorded.

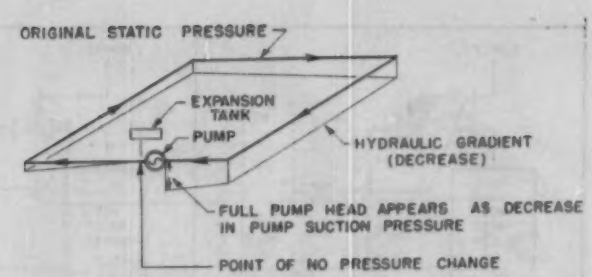
Thermocouples are located in air handling units, piping systems, and in various rooms throughout the building. This equipment permits the operator to check individual equipment and system operation and determine the general location of difficulty in emergencies.

The mechanical contract including the heating, piping, and air conditioning systems totaled $1,414,000. The total construction contract was $4,558,000.

The mechanical (heating, piping, and air conditioning) contractor for this installation is Belden Porter Co. The ventilation contractor is Midwest Sheet Metal Works. ⧺


HYDRAULIC GRADIENT (INCREASE IN SYSTEM PRESSURE ABOVE ORIGINAL STATIC PRESSURE AFTER STARTING PUMP
EXPANSION TANK
ORIGINAL STATIC PRESSURE (SYSTEM PRESSURE PUMP NOT OPERATING)
FULL PUMP HEAD APPEARS AT DISCHARGE SIDE OF PUMP
PUMP
POINT OF NO PRESSURE CHANGE

17 PRESSURE DROP due to pipe friction will gradually decrease system pressure from pressure existing at pump discharge to lower pressure existing at suction. (Figs. 1 through 16 were in the April and May issues)


ORIGINAL STATIC PRESSURE
EXPANSION TANK
PUMP
HYDRAULIC GRADIENT (DECREASE)
FULL PUMP HEAD APPEARS AS DECREASE IN PUMP SUCTION PRESSURE
POINT OF NO PRESSURE CHANGE

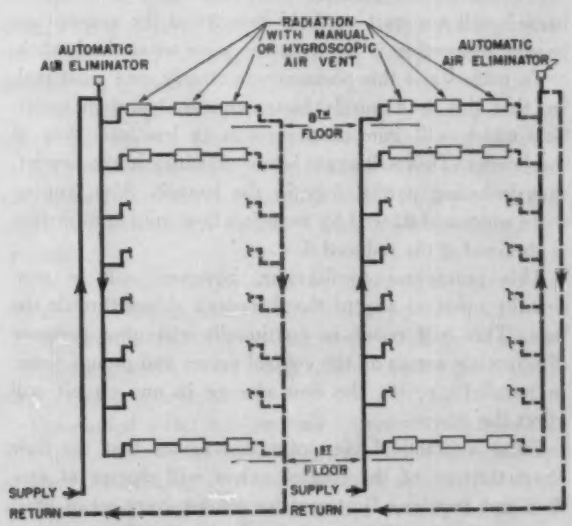
18 SINCE JUNCTION of tank with system indicates *no pressure change* and since pump creates pressure differential only across itself, full pumping head will appear on suction side of pump

How to Prevent Unbalance In Hot Water Heating

. . . *by careful design, proper installation*

In the April and May issues the author discussed the evolution of hot water heating and the efforts made to correct the problem of system unbalance, and described various system types. Here he presents some valuable installation pointers.

BY T. ROBERT STEVENS
Vice President
Sarcotherm Controls, Inc.

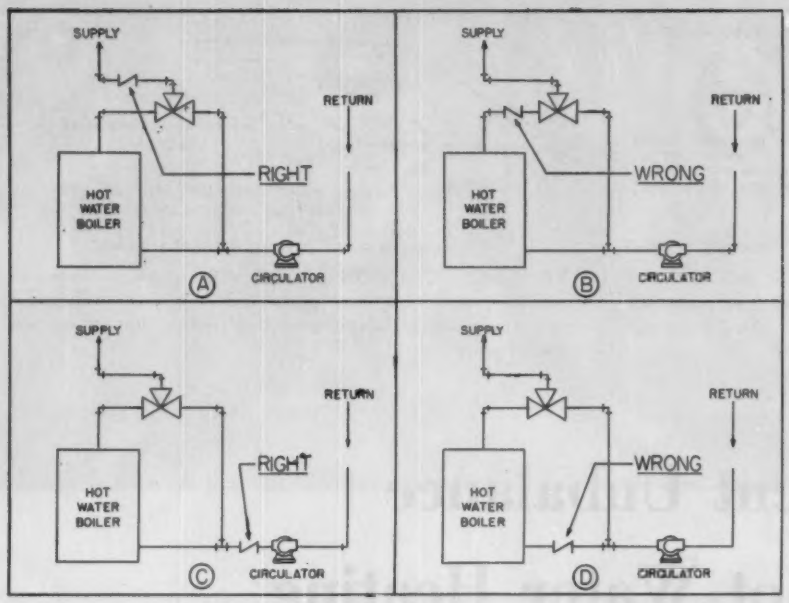


19 IN PLACING air vents at high points, it is best to run supply main directly to air vent

IN CONSIDERING the basic principles of hot water heating, one must not overlook the fact that problems of installation, piping, equipment connection, etc., can very definitely influence the performance of a system. Among the many field problems, the few described below are perhaps the most troublesome in that they often cause difficulties which seem not readily explainable.

1) Pump location relative to expansion tank has not been given much thought until recently. Much of the experience design engineers have had with hot water heating systems has stemmed from residential applications. Here, it is customary to connect the expansion tank at the boiler outlet and place the pump in the return line. In effect, the tank is connected at the pump discharge. Under these conditions, when the pump starts, a pressure difference or pump head will appear across the pump in addition to the static pressure which is constant.

As shown in Fig. 17, pressure drop due to pipe friction will gradually decrease the system pressure from the pressure existing at the pump discharge to the lower pressure existing at the suction. Since the junction of the expansion tank with the system indicates a point of *no pressure change* and since the pump creates a pressure dif-



20 FLOW CONTROL or weighted check valves, often used to prevent gravity circulation, should be placed on lines of constant flow when used with three-way valves. If not, throttled flow to hot water or return ports will cause weighted check to drop

ferential only across itself, the full pumping head will appear on the suction side of the pump, as in Fig. 18.

The pressure decrease at high points in the system may be sufficient to cause a negative pressure or vacuum. Therefore on high head systems the compression tank should be connected to the suction side of the pump to prevent air bound, unventable circuits caused by vacuum, unstable water flow due to system boiling (because of reduced pressure) and possible cavitation of pumps.

2) In placing air vents at high points it is usually preferable to run the supply main directly to the air vent. This would then be feeding down to circuits rather than the reverse, as shown in Fig. 19. It is true that the latter method facilitates venting when the system is filled from the return; however, during normal operation the former method will get rid of air before it reaches the heating surfaces. This is especially helpful in radiant heating systems where air venting can be more critical because of the use of small diameter piping with many pipe bends.

The fundamental point to remember, however, is that venting of large mains requires large capacity float vents which are rated above maximum water pressure at the vent. Air eliminators with small venting capacity usually cause air bound circuits for some time after start. The result is uneven heating.

Hygroscopic vents are fine on small radiators where air has already been expelled from the mains through large air vents. However, their extremely small capacity make them unsuitable for venting mains.

3) Flow control or weighted check valves are often used to prevent gravity circulation when the pump is not in operation. When used with three-way valves they must be placed on lines of constant flow. Otherwise, throttled flow to the hot water or return ports will cause the weighted check to drop. This is illustrated in Fig. 20.

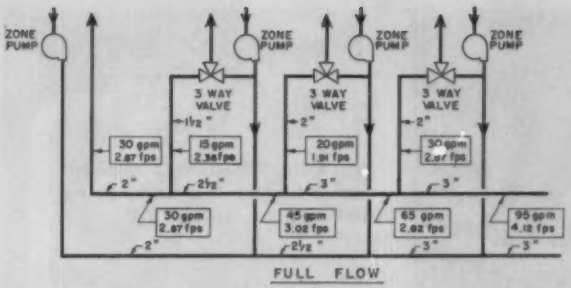
4) Perhaps the most troublesome and least recognizable problem is that of the undersized supply and return header on multizone systems. It is often customary to size the header on heat carrying capacity, just like any of the risers and runouts.

Fig. 21 shows a typical four-zone system with three 3-way modulating valves and one "wild" zone. The header pipe sizes are based on a 300 mill in. per ft drop, which is considered good practice. Note, however, that the velocities plotted indicate a higher velocity at some points in the header than at the branches. Pressure drop in a pipe is proportional to the square of flow velocity. Therefore, at every point where the header velocity exceeds the branch velocity, the pressure drop across that portion of the header will be greater than across the branch. As water follows the path of least resistance, flow in the branch will not start until the velocity at the appropriate header connection is lower or the same as at the branch.

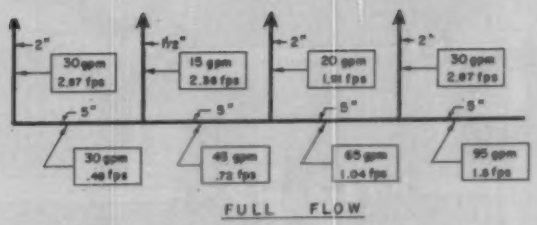
To understand this phenomenon clearly, one must realize that this is a purely instantaneous, transient condition which will immediately result in less total flow in the header. This will cause lower velocities in the header, thus inducing partial flow in the branch. Also, one or more zones are starved by reducing flow until equilibrium is obtained at the reduced flow.

This precarious equilibrium, however, will be continually upset as any of the three-way valves throttle the flow. This will result in continually changing pressure differentials across all the control valves and pumps since, in parallel circuits, the flow change in one circuit will affect the others.

From a practical viewpoint this means that the flow characteristics of the control valves will change at random and require adjustment for almost every set of pressure conditions. This is obviously impossible to accomplish. The result must be erratic control. This condition



21 FOUR ZONE SYSTEM with three 3-way valves shown here. Header pipe sizes are based on 300 mill in. per ft drop



22 HEADERS should be sized for velocities not exceeding 1 to 1.5 fps at maximum flow, as is shown here

would immediately disappear if the header were an open reservoir type with zero velocity (thus resulting in zero pressure drop), because each circuit could then establish its own flow without affecting that of the others.

In practical piping, however, one must limit the pipe size. Satisfactory results are obtained by sizing the headers for velocities not exceeding 1 to 1.5 fps at maximum flow. Fig. 22 shows the same four-zone system with headers sized on a velocity of 1.5 fps. This indicates that the header velocities in every instance are lower than the branch velocities at maximum flow.

It has long been recognized that hot water heating has the desirable features of low temperatures and elimination of rapid fluctuations. Where these systems have been properly designed, installed, and controlled, these features have been proven. No heating medium will give satisfactory results, however, when basic engineering principles are ignored. ⫩

Natural Gas Absorption System Selected for New Motel

. . . for quiet operation

AN ABSORPTION TYPE air conditioning system featuring a 25 ton steam operated water chiller serves the new 32 unit Gettysburg Motor Lodge in Gettysburg, Pa.

This type of system was chosen primarily from the standpoint of quiet operation and economical operating cost, with a natural gas fired steam boiler serving both the cooling and heating equipment, except pumps and accessories, of course.

Individual thermostats in each room permit guests to select the desired temperatures and either conditioned cool air or filtered outside air. Chilled water or hot water continuously circulates through a zoned piping system to individual room units equipped with coil-blower-filter assemblies.

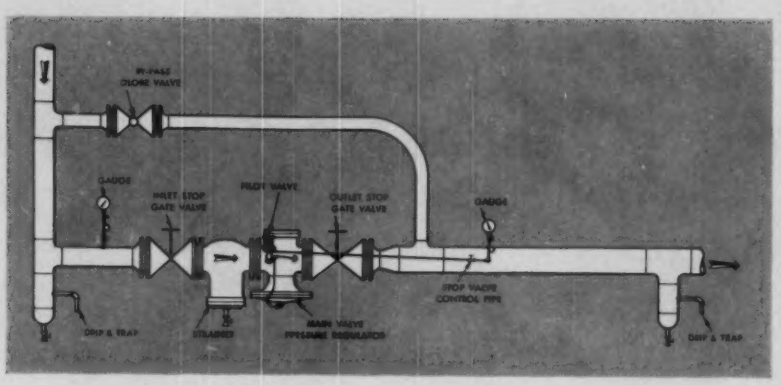
The hot water is supplied by a steam-to-water converter. The heating load is 450,000 Btu per hr.

An evaporative water cooling tower cools the condensing water for the water chiller. The cooling load is 21 tons.

The chilled water temperature is maintained constant. The hot water temperature is controlled by an indoor-outdoor modulating type control. Both the chilled water and hot water controls operate steam valves to the absorption type chiller and converter, respectively. The system is now set up for manual summer-winter changeover requiring only two valves, and may be switched to automatic changeover at a later date.

WATER CHILLER maintains constant chilled water temperature. Individual thermostats permit guests to select desired temperatures and either conditioned cool air or filtered outside air

The heating and air conditioning contractor was the H. N. Bange Co. ⫩



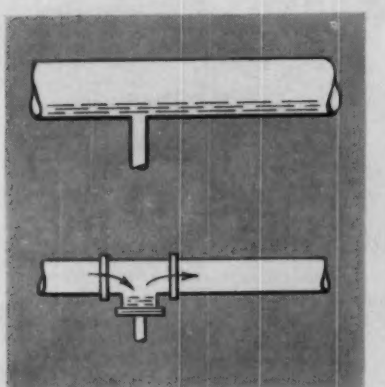
1 WELL DESIGNED regulator station has bypass and stop valves for easy, safe startup

Safety Cuts Maintenance Costs

. . . in pressure or temperature regulating stations for control of steam, other gases

BY E. GRAFE
Field Engineer
Spence Engineering Co., Inc.

SAFETY is one of the primary requirements of a pressure or temperature regulating station for the control of the flow of steam and other gases. Numerous codes govern the construction of the individual pieces of equipment that make up such a station while others govern their selection for given conditions. For example, certain valves are designed to fail shut. One valve of this type is designed to open against pressure, and the valve disc automatically seats itself, stopping the flow in the event of any mechanical failure.



2 CONDENSATE will be carried past drain connection to trap in top drawing. "Tee" or separator should be used, as shown in lower drawing

Well designed regulating stations may become hazards through oversight, construction errors, or improper handling. For instance, safety valves are often sized to relieve the required load at some given rise above controlled pressure. This method of sizing does not make allowance for the fact that a pressure regulator's wide open capacity will always exceed, to some degree, the requirement of the system which it feeds. The safety valve should be sized to handle the ultimate capacity of the regulator at the permissible rise in controlled pressure.

Safe Venting Often Overlooked

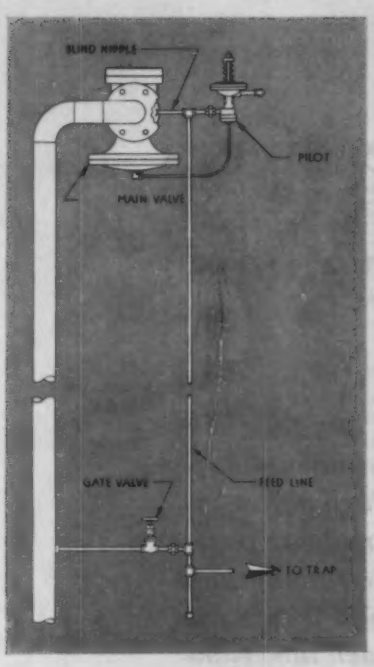
A safe venting arrangement for the safety valve is often overlooked. In one apartment house a safety valve was vented directly into the equipment room. It opened and relieved pressure when dirt lodged under the disc of a regulator. Before a shutoff valve could be reached and closed, the steam had blown a considerable amount of insulation off the equipment room ceiling. Most of the electrical equipment in the same space was saturated. Omission of the few feet of pipe required to carry the safety valve discharge outdoors in this case was no economy.

The outdoor discharge should be so located that it will not harm anyone nor cause damage to property.

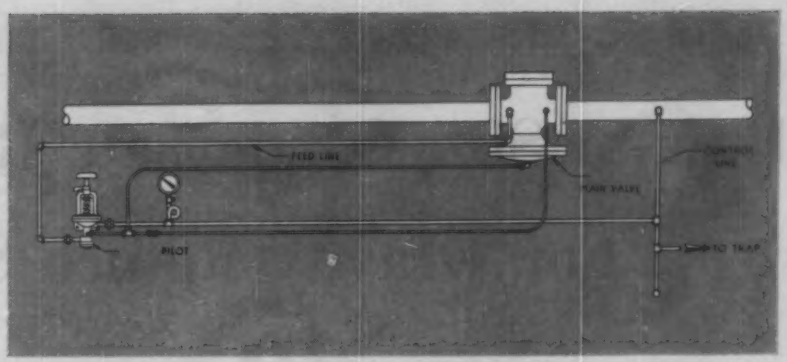
Are Traps Adequate?

The dangers of water hammer in a steam system are recognized and yet there are many existing installations in which condensate, forming faster than it is removed, has caused trouble or still exists as a danger. In one case, an underground distribution main has a low point which is swept dry when the load is substantial. After periods of low load, however, condensate that has collected at the low point is picked up and is carried through the line when the load increases. The piping swings in its hangers and pounds dangerously.

In another underground installation, the piping passes through manholes which flood from time to time.



◀ **3a** GATE VALVE in control line to pilot provides inexpensive method of controlling main valve from point up to 50 ft from main valve



▲ **3b** PILOT is placed conveniently for adjusting where frequent change or shutoff is needed

During floods the condensation rate increases beyond the capacity of the traps installed. This problem was brought to light when condensate washed dirt from the system into regulating valves, holding them open and causing safety valves to blow. Dirt was also washed into the traps, plugging them and worsening the situation.

Avoid Careless Startup

In still another installation the startup procedure was careless. Traps sufficiently large to carry off condensate as it formed in a hot system could not handle the large volumes brought to them on a fast start without the proper warmup. Condensate was carried into the regulator with such force that the pilot blind flange blew off.

Placing a regulator on stream after a long shutdown when the system is cold should be done with care. With the regulator isolated by closing the stop valves, heat up the downstream line by admitting a small amount of steam through the bypass. Then crack open the downstream stop valve. Crack open the upstream valve which will admit steam to the pilot and open the main regulating valve. Gradually increase the flow until it is normal and is being handled by the regulator. If there is water in the system, the downstream stop valve, when still throttling, will prevent water from entering the system. The stop valve will prevent the rush of uncontrolled steam into the system in the event that water hammer damages the regulator upon initial startup, as illustrated in Fig. 1.

Trap connections to a main are sometimes found so arranged that the main will be adequately drained when the flow — and the velocity — is low. But condensate will be moving too fast and will pass the connection when loads and velocities are higher, as shown in Fig. 2.

Dirt Legs, Strainers Vital

Trapping considerations are particularly important as they apply to temperature regulation since these are, more than pressure regulators generally, subjected to wide and fast fluctuations in load. They are also subject to extended periods of dead-end shutoff when condensate can form and collect in the absence of careful trapping.

Temperature regulation, especially as applied to domestic hot water systems, introduces additional problems of safety. Inclusion of a pressure-temperature relief device on the water side of a heater is taken for granted as is, in some cases, a safety valve on the steam side. But these devices usually permit water temperatures to reach 180 F before relieving.

If the thermostat is so located that it cannot sense a temperature change quickly (if it is perhaps only one-half or one-third submerged in the flow or if it is too far from the heater outlet) a similar condition can be set up.

Consider Remote Control

Manual remote control or at least remote shutoff should be considered if the continued flow of steam is hazardous under certain conditions in chemical and other industrial processes. Automatic remote shutoff tied in electrically with other steps in a process, as shown in Fig. 3, should also be examined as a safety measure.

All of these problems have been discussed here in terms of their effect on a system's safety. This alone justifies the greatest care in system design, inspection, and operation. Also, the maintenance cost, increased by such system weaknesses, is a double reason to justify their correction. ⧺

How to Size Condensate Receivers For Gravity Return Systems

Through a comprehensive study the author has devised a new method for correctly sizing receivers for condensate return. The method considers the elements which affect receiver size, and concludes that the amount of makeup water added to a system is the determining factor. Calculating this amount requires careful evaluation of how long it takes to add the makeup water to the boiler and how much the evaporation rate affects this time lag and quantity.

BY TOM E. KRIEG
Engineer
Tom Krieg Co.

THE PRIME FUNCTION of a condensate receiver is, of course, to hold water. It should be of sufficient size to hold all the makeup water added to a system during startup. Also, it should provide room for expansion and flashing or venting of noncondensibles. Presented here is a method for correctly sizing condensate receivers so that they will perform their proper function in a gravity return system. This method will also avoid needless makeup or waste of solidsfree (distilled) water in the form of condensate.

A correctly sized receiver will prevent rapid buildup of scale in boilers operating on intermittent duty. This scale affects the life as well as the efficiency of the boiler. Where treated water is being used for makeup, it will keep the operating cost within calculated requirements.

Systems with boilers rated at outputs of 500,000 Btu per hr or more require careful consideration when sizing condensate receivers. While some smaller systems can be affected by scale buildup, the condition does not appear to be as critical where the length of connected pipe and fittings is relatively short.

Anyone familiar with pipe sizing as suggested in the ASHAE Guide can use the method given herein. First, the loading should be determined and Table 7, Chapter 20 of the 1957 or 1958 Guide may be used for this.

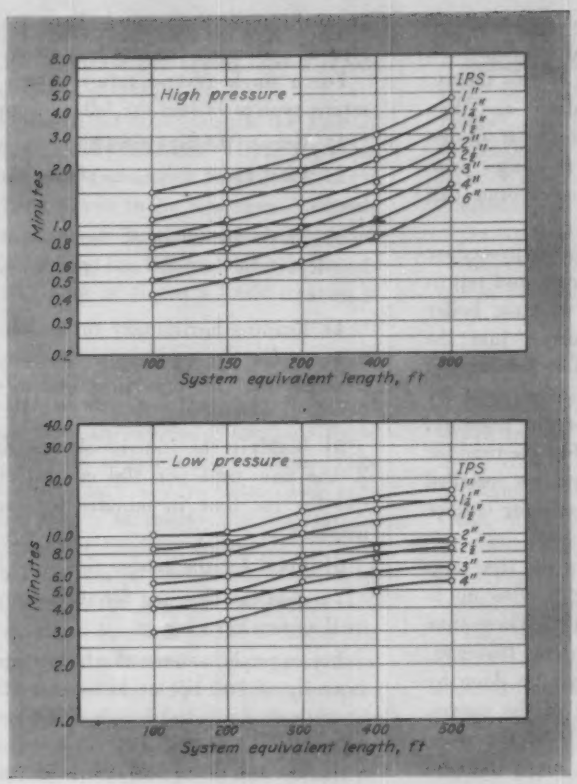
This entire method is based on the premise that it is possible to predict the time for condensate to return by gravity to the receiver.

What Type of System Should Be Used?

Should the return system be a condensate return or a boiler feed type? The basic difference between these two types is in the location of the pump control and the makeup feed valve. The condensate return system normally includes a small receiver designed to hold about a 3 min supply of water between the pump starting and stopping points. The pump is controlled by a float switch mounted on the receiver. This switch acts independently of actual boiler needs. A makeup feeder is usually installed on the boiler to maintain a minimum water level independent of the pump.

The boiler feed system is normally designed to hold condensate in reserve until the boiler requires it. The pump control is actuated by the change in boiler water level between pump start and stop. The makeup feed valve is usually installed on the receiver to maintain a minimum reserve and to replace water lost due to evaporation, leaks, vent loss, etc.

When should a change be made from a condensate return system to a boiler feed system? Condensate return systems should be used until the calculated makeup added to the system will cause a storage rise not in excess of 2 in. in the normal water level of the boiler. If the makeup will cause the normal water level to rise more than



1 TIME FOR CONDENSATE to flow 100 equivalent ft within both high and low pressure systems is plotted here for commercially available pipe sizes. High pressure curves are based on system with 30 psi steam main, return line pressure of zero to 4 psi flash steam pressure, system pressure drop of 1 psi. Low pressure curves assume 2 psi steam main pressure, zero to 1 psi return line flash steam pressure, ¼ psi system pressure drop

2 in., it is recommended that a boiler feed system be installed. This 2 in. rise in water level should not cause undue difficulty in most boilers during startup.

What Determines Size of Receiver?

To establish a point of reference it is important that the factors affecting the size of a receiver be considered. The most obvious of these are:

1) Percentage of condensate returned. For this it is assumed that 100 percent of the condensate would be returned. No allowance for leaking feeders or other malfunctions has been considered.

2) Makeup water capacity or potential. Size of the valve, water pressure, flowing capacity of makeup line, and source of water can affect the storage requirement. In this it is assumed that only minimum makeup would be required.

3) Demands on makeup valve capacity. Will 100 percent be made or bypass for filling be used? For this it is assumed that a bypass would be available for the initial filling of the boiler.

4) Amount of space required for expansion and venting. This is arbitrary, as the shape of the receiver can affect the volume. For this analysis 25 percent has been chosen as a standard.

5) Amount of makeup water storage space required. This is a function of the time lag of the system. The space should be available for the amount returned.

A suggested formula used in this article is based on 100 percent return of the condensate. The receiver sizing is assumed to apply to boiler feed systems and not to condensate return units.

Let:

x = amount of calculated makeup water added to system

and:

$x/2$ = amount of calculated makeup water added to system space for expansion and venting.

Then, adding:

$2x$ = tank capacity.

There is still one unknown, which is x gallons of makeup water added to the system. This amount then is the critical or determining factor in receiver sizing. Makeup water is added to a boiler so long as there is no condensate returned to the receiver to stop it. The time lag determines how long this takes place and the evaporation rate determines the quantity required in this length of time. Therefore it is necessary to evaluate the time lag.

Why a Time Lag?

The time element is the only common denominator—other than poorly installed systems and mechanical malfunctions—that really affects the amount of makeup water. The major stumbling block has been the lack of a method for predicting a system time lag.

In the design of steam piping, the common theory of using reasonable steam velocity for determining flow

rates in filling a system is generally followed. To establish a time for filling a system is considered fundamental. The method used in this article is similar to this theory. The volume of the steam mains is calculated and then divided by the specific volume of the steam at design pressure. Knowing the evaporation rate at design pressure, it is possible to establish the time to evaporate this amount of steam.

To derive the return side time, the following procedure has been used: Starting with an empty steam and return system (one shut down overnight), and with the boiler at system design pressure, steam is turned into the system as a control for the time function for supply. This action on the traps has not been investigated by comparing with a gradual buildup of steam pressure. The pressure selection of trap rates can affect the time for condensate to enter the return system where not installed with adequate hydraulic head to compensate for lack of pressure during startup.

Fig. 1 provides a means for predicting the time lags in high pressure systems with equivalent lengths up to 800 ft and low pressure systems up to 500 ft. These time predictions have proved to be very accurate. However, further field and laboratory testing should be done by others to definitely establish the validity of the curves. When proved, the curves can also be used for other purposes such as examining trouble jobs, analyzing piping systems to get faster responses, and checking installation details.

How to Use Curves

The curves in Fig. 1 are labeled for commercially available pipe sizes. To use the curves it is necessary to know the type of system and its equivalent length. The type of system determines how much work is involved.

For a single reverse return system or a first fed last return type of system the following procedure is used:

1) Itemize the pipe sizes and each equivalent length.

2) Total these values to obtain the system equivalent length.

3) Enter the chart at the nearest system equivalent length at the bottom and rise to the individual pipe curves.

4) Reading horizontally to the left then is the time in minutes for the condensate to flow 100 equivalent ft through that size pipe in a system with an equivalent length as entered.

5) Multiply the individual pipe lengths (equivalent) × the flow time per 100 equivalent ft and divide by 100 for the time in minutes for each size and length involved.

6) Total for the return side time lag.

7) Add the time lag for the supply side to obtain the total system time lag.

For example, assume that a low pressure system has a capacity of 100 hp, or an output of 3,345,000 Btu per hr, with an equivalent length of 300 ft.

Then:

1 in. — 50 ft × 13 min)/100 = 6.75 min
1½ in. — 50 ft × 10 min)/100 = 5.0 min
2 in. — 50 ft × 7½ min)/100 = 3.75 min
3 in. — 150 ft × 5.5 min)/100 = 8.25 min

Therefore:

Total time for return side = 23.75 min on startup.

Assume that the supply side has a 4 min delay; then the total time is 27.75 min. Next, enter the top of the

TABLE 1—FOR GIVEN BOILER SIZE, correct receiver tank selection can be easily made if system time is known. Use curves in Fig. 1 to derive system time

Boiler hp	Output, Btu per hr (in 1000's)	Makeup, gal per 10 min	Pump flow rate, avg. gpm	System time, 15 min gal	Float control storage, gal	System time, 20 min gal	Float control storage, gal	System time, 30 min gal	Float control storage, gal
5	167	3.5	1.05	10	2.5	15	3.75	20	5
10	334	6.9	2.07	20	5.0	30	7.5	40	10
15	500	10.4	3.12	30	7.5	40	10.0	60	15
20	668	14.0	4.2	40	10.0	60	15.0	80	20
30	1000	21.0	6.3	60	15	100	25.0	125	30
40	1339	28.0	8.4	80	20	125	31	175	40
50	1674	35.0	10.5	100	25	150	37.5	200	50
60	2008	42.0	12.6	125	31	175	44	250	62
70	2330	48.5	14.55	150	37.5	200	50	300	75
80	2678	56.0	16.8	175	44	250	62	350	87.5
100	3345	69.0	20.7	200	50	300	75	400	100
125	4184	87.0	26.1	250	62	350	87.5	500	125
150	5021	105	31.5	300	75	400	100	600	150
200	6695	140	42.0	400	100	600	150	800	200
250	8369	174	52.2	500	125	700	175	1000	250
300	10,043	210	63.0	600	150	800	200	1200	300
350	11,716	244	73.2	700	175	1000	250	1400	350
400	13,390	280	84.0	800	200	1200	300	1600	400
500	16,737	350	105.0	1000	250	1400	350	2000	500

Pump gpm: Nominal selection is three times the evaporating capacity. On high pressure boilers two times the evaporating capacity will affect the steaming rate less and will reduce the shock effect to the boilers if the water is cold.

Tank capacity: Gallons listed under the different system times are based on having only 25 percent of the tank for storage. If a conventional boiler feed system is used, increase the tank size by the amount of the float control storage capacity.

Control: Use a pump control mounted on the boiler. A makeup feeder on the tank will maintain the reserve indicated.

DO NOT USE A FLOAT SWITCH ON THE TANK TO START AND STOP THE PUMP. THE MAKEUP VALVE MUST BE A TIGHT SHUTOFF TYPE. USE A V-PORT FLOAT VALVE OR FLOAT SWITCH ACTIVATING SOLENOID VALVE ON THE MAKEUP WATER LINE.

System time: The system time curves are predicated on a minimum grade of 1 in. per 40 ft, well reamed and vented and with no pockets.

CAUTION: On high pressure systems using blast type traps to lift the condensate to overhead returns, allow extra time for the pressure buildup to start the condensate back to the boiler room or receiver. On steam lines using control valves for zoning, it is possible to produce a high vacuum when the steam condenses. This would work against the return system if any lifts are involved and, in general, destroy the efforts of the time curves. This would require definite venting of the return line even on vacuum return systems.

table in the 30 min system column and read down opposite the 100 hp or 3,345,000 Btu per hr output rating. This gives the receiver size as 400 gal.

The rate of evaporation for this boiler is 6.9 gpm × 27.75 min, or approximately 192 gal. Then, according to the formula for receiver capacity, 2 × 192 = 384 gal.

The error has been found to be less than 5 percent in sizing condensate receivers by this method. Float controlled storage is 25 percent of 400, or 100 gal. Normal pump flow rate is 20.7 gpm, or almost a 5 min reserve.

How to Calculate Other System Types

Some buildings are so arranged that multiple supply and return runs are used. In practice it has been found where these are of the reverse return type that using the longest equivalent length unit will in most cases have sufficient condensate return to satisfy the makeup demands and provide for the time lag factor.

Where the return system is the direct type it is necessary first to examine the loading for distribution. Determining the equivalent length requires a condensing load adequate to prevent further makeup requirements. The makeup water needs will be different though, as the flow length for steam is less close to the boiler. Use of the progressive columns for evaporation or condensing rate *vs* the time involved sets the probable makeup requirements. By readjusting for the equivalent length of the system it is possible to narrow the error down. The direct return system is the most difficult to compute.

Installations using more than one boiler present a problem as to the demand for steam from each boiler on a cold startup. It is suggested that a study be made investigating a control system against the cost of storage space requirements. This control system would provide a means of possibly delaying the condensing action of large heating users such as fan-coil units, outdoor air heaters, etc., until system pressure is equalized. This would permit analysis of the steam demands, and would balance against the time lag on startup for the return of condensate to the receiver.

On systems larger than 500 ft equivalent length it seems more practical to install condensate return units out in the system to pump back to a central receiver.

Results 90 Percent Accurate

Through this study, a working tool has been formed which can be used in place of rule of thumb formulas. Since it is a relatively new concept in an area lacking published data, it is recommended that each user first check in his own area to see if the time predictions are of sufficient accuracy to satisfy reasonable confidence. It is expected that refinements should occur if enough testing is done.

The limited number of systems used in developing the curves indicate that results within 90 percent of calculated time are possible. Random checking of systems where building or plant engineers have modified existing return systems to get adequate receiver capacity has shown this to be true.

This method requires an understanding of the problems involved to obtain results properly. Taking the variables that can apply and examining them against the study should allow the engineer to make any adjustment deemed necessary. It is suggested that the formulas given be followed until the user feels confident in the application of the curves and tables. ⧺

Twin Units Heat, Cool Planetarium

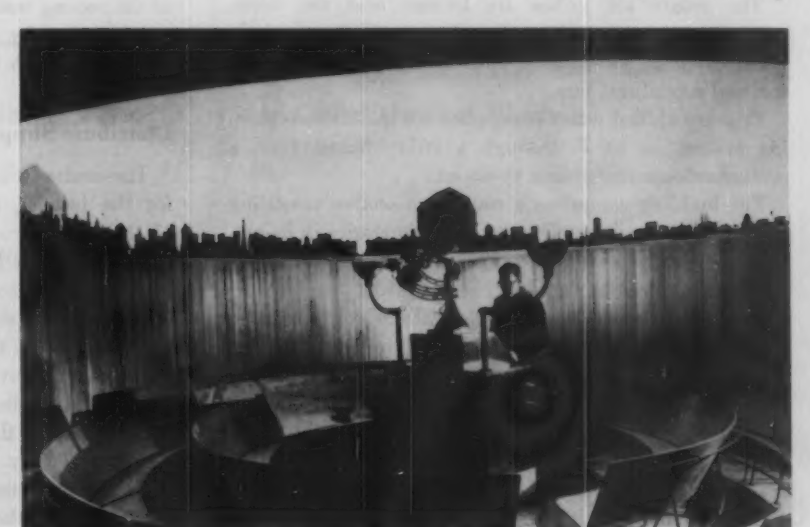
. . . at Butler University

THE HEAVENS are air conditioned at Butler University in Indianapolis, site of the J. I. Holcomb observatory and planetarium, according to Bryant Div., Carrier Corp.

The building is divided into an east and west wing, with the latter containing the planetarium. A circular room, it is covered by a dome with a 12 ft radius. Concealed in the border of the dome are the diffusers.

An office, too, is heated and cooled by the same equipment, consisting of an oil fired heating unit and a matching water cooled air conditioner.

In the east wing a projection room and lecture hall is heated by an oil fired forced air furnace. ⧺



Condition Court Building Three Ways

- *courtrooms use low pressure system*
- *justices' suites use double-duct high pressure system*
- *offices use four zone system*

NEW SUPREME COURTS BUILDING consists of two sections — courtrooms, left, and offices, right. Two 35,000 cfm central plant air handling units in the second basement receive chilled water through a tunnel from a central refrigeration plant

BY JAMES M. PURDY
Blum & Guerrero
Consulting Engineers

STEEL STUD PARTITIONS, open at the top of the space above the ceilings, are utilized for return air shafts in the new supreme courts building on the State Capitol grounds, Austin, Texas.

The return air grilles are located near the floors, adjacent to the outside walls. Return air is positively recirculated by two 35,000 cfm single inlet, backwardly inclined centrifugal fans.

Primary chilled water is supplied for the air conditioning system, at 34 F, through a utility tunnel from a central refrigeration plant.

The building comprises a courtroom section consisting of four floors, and an office section eight stories in height, with two basements under the entire structure. Construction features an unusual "checkerboard" window arrangement in reinforced concrete walls which are faced with Texas granite. The inside finish of the walls is plaster furred on metal lath.

The total refrigeration load is 420 tons. Cooling of the greatest portion of the building is accomplished by the use of two 35,000 cfm central plant air handling units in the lower basement.

Each of these units has a high velocity, cleanable filter bank, eight row chilled water coil, steam heating coil and a double inlet, double width, forward inclined centrifugal fan driven by a 75 hp, 480 v, three phase, 60 cycle electric motor. A secondary chilled water pump, adjacent to each unit, with a three way control valve installed on the suction side of the pump, maintains a constant water flow through the coils. The temperature of the cooling water is varied in accordance with building requirements by mixing varying quantities of recirculated water with the 34 F primary water supply.

Distribute Supply Air Three Ways

The courts section of the building provides office suites for the justices, and all the courtroom facilities. Each of three large courtrooms is served by a conventional, low pressure air handling unit. The air distribution system for these spaces utilizes rectangular sheet metal ducts lined with 2 lb density, vinyl coated glass fiber material providing both thermal insulation and acoustical advantages. Comfort conditions in the courtrooms are automatically controlled by the use of a return air humidistat which positions the coil water temperature control valve as demanded by the concentration of courtroom latent heat. A thermostat adjacent to the humidistat controls a steam valve on the reheat coil to produce the desired dry

bulb temperature. Adequate quantities of outdoor air are constantly delivered into these spaces, and this excess air is relieved through the equipment rooms and finally exhausted through the utility tunnel.

An office suite for each justice consists of private office area, library, clerk's quarters, and reception-secretary-waiting room space. The two latter spaces are, in every case, interior spaces. The two spaces reserved primarily for the justice have exterior exposure. All rooms within a suite are interconnected.

Air is distributed to all of the suites through a system of double ducts carrying air at an initial velocity of 4000 fpm and exerting a total static pressure of 6.5 in. water gage on the supply fan. Control of temperatures within each suite is accomplished by two thermostats; one serving the two interior spaces and controlling the supply air temperature discharged from the sound attenuating and air mixing box above the ceiling of each of the two spaces, the second thermostat performing a similar operation in the exterior spaces.

A third type of supply air distribution system is used in the office section of the building, which presented a less critical control problem. Therefore, a four zone air unit, pumping air at a maximum velocity of 4000 fpm and a total static pressure of 6.5 in. WG, supplies a north zone, south zone, west zone — in which all glass was omitted — and interior zone. The air temperature to each of these zones is controlled by an averaging type thermostat on each floor.

The latter two air systems further utilize an outside air temperature compensator type of control. A modulating outside air damper allows increased amounts of outdoor air to be admitted to the building when the outside temperature falls below inside design temperature until, at an outside temperature of 60 F, the system is supplying 100 percent outdoor air. This results in less refrigeration being required during days of 60 to 78 F temperature than would otherwise be satisfactory and does not require refrigeration at all during weather of less than 60 F except as might be required for dehumidification. The excess air is constantly and automatically discharged into the mechanical equipment rooms to provide more than adequate ventilation in these spaces.

All Systems Use Same Type of Return

Although each of the five air supply systems has an independent return air system, the same principle is employed throughout the 140,000 sq ft of air conditioned space. All interior partitions are constructed of 4 in. steel open web studs resembling small bar joists, with metal lath and plaster finish on both sides. Ceilings are suspended on channels and lath with plaster finish also. Studs for partitions continue up and are attached to the concrete floor slab above, but plastering begins at ceiling level.

This arrangement provides a 4 in. wide shaft through which return air is drawn from each room. Supplementary return openings are in corridor ceilings, public spaces, and other strategic locations to provide adequate air circulation and to insure noiseless operation.

30 Ft High Lobbies Have Radiant Panels

A radiant heating and cooling panel is provided in each of two glass enclosed entrance lobbies, which feature ceiling heights of approximately 30 ft. These panels supplement normal heating and cooling available from the air system and are designed to absorb the radiation loads only.

The entire heating and cooling system, including 300 ft of utility tunnel, cost $325,000, which was several thousand dollars less than the estimate used in establishing the $2.5 million budget for the overall project.

The new building was designed by an association of architects comprising the firms of Page, Southerland, and Page; Jessen, Jessen, Millhouse, and Greeven; and Mackie and Kamrath. The mechanical (heating, piping, and air conditioning) contractor was Porter Plumbing and Heating Co. ≠

Jets' Conditioners Made in Air Conditioned "Lab"

. . . to meet precision requirements

AIR CONDITIONING equipment requiring greater precision than a wrist watch is being produced today for one of our new jet passenger planes, according to Carrier Corp.

Instead of on an ordinary production line, these unique cooling units are turned out in carefully air conditioned, laboratory-like surroundings where technicians work to achieve accuracy within a 50th part of a human hair.

The "Mighty Mite," a compact and powerful air conditioner which demands exacting precision so its tiny parts can move at supersonic speeds, won its name because the compressor weighs only 8 lb.

The unit recently leaped from the drawing board to the production line following an order of 150 units from Douglas Aircraft for its fleet of DC-8 jets. Two systems will be used in each plane, each weighing 150 lb.

Air conditioning itself plays an important part in producing this revolutionary unit. Conditions in the production area are rigidly controlled so that measurements will not be thrown off by variations in temperature. Engineers explain that a 5 F deg change could mean an error beyond tolerances. ≠

Sheet Metal Ducts Are Solution

. . . in balancing heating for multistory apartment buildings

Tight sheet metal ducts installed in plumbing pipe shafts prevent floor-to-floor leakage, thereby greatly reducing chimney-like effect of shafts through building. Engineers would do well to stress that shafts be built solid, that openings for pipes be sealed to minimize leakage.

BY LEWIS SMITH
Heating Engineer

MANY MULTISTORY apartments are designed for increased radiation on upper floors to compensate for infiltration. But stack effect is real culprit

MANY consulting engineers when designing multistory apartment houses (more than 10 stories) are inclined to design for more radiation on the upper floors than on the lower floors to allow for greater infiltration due to wind velocity at the higher levels. Experience indicates, however, that there are other factors which may be more important than exposure. In many cases such an increase in radiation is exactly the wrong procedure.

High buildings tend to act as chimneys. Theoretically, in a perfectly constructed building this would do no harm because each floor would be sealed off from all others. There would therefore be no way for heat to flow from lower to upper floors. Since such a perfect building does not exist, there is always some stack effect, and this effect usually causes more trouble than does exposure.

If bathrooms and kitchens have outside walls with windows and have no mechanical ventilation, and if the plumbing shafts are sealed off at each floor, there is likely to be little stack effect in the building.

Under this condition, if a building

To Critical Stack Effect Problem

is critically exposed to the wind (especially if the lower part is protected by other buildings) increasing the radiation on the upper floors may seem logical. However, there is still enough leakage into and through the plumbing shafts and through stair wells and elevator shafts to cause some piling up of heat on the upper floors, thereby making the addition of radiation on those floors unnecessary.

An example of the effect of wind, although not related to stack effect, is the case of a 13-story building standing on high ground and unprotected from the wind. During a high wind the air would literally blow straight through the building — in one side and out the other. All floors on one side would be affected equally. There would be a difference of 10 F deg on some days between exposed and sheltered apartments.

Of course it might readily be argued that the foregoing is a good example of the need for increasing the radiation on the upper floors if the building had been protected by six-story structures across the street. Actually, these high winds were infrequent and not of long duration. At all other times the stack effect in the building was sufficient to compensate for excess infiltration due to the wind.

In the case of this particular building it was found that the steel frame casement windows were not closing properly. After this condition was corrected, the leakage was reduced to normal values.

Most of the time the stack effect in the building was ample to compensate for excess infiltration due to wind. It is more economical to tolerate overheating of the protected areas for 10 percent of the time than to overheat the exposed portions 90 percent of the time due to excess radiation. There is a better argument here for zoning for exposure.

If interior bathrooms and/or kitchens are used, with mechanical ventilation provided by roof fans, serious problems can arise which may require that the radiation on the upper floors be substantially reduced below the normal calculated amount, and at the same time increased on the lower floors.

What is the reason for this? Are sheet metal ducts inside the plumbing pipe shafts? If not, and the shafts alone are used as ducts, it is literally impossible to seal off the many openings into these shafts so completely that leakage is eliminated. The shafts in such a case become chimneys and the natural draft thereby created is strong. In fact it may be so strong that on really cold days there would be a far greater suction into these shafts on the lower floors than on the upper, in spite of the fans.

Infiltration on the lower floors is greatly increased with a reduction on the upper floors and the radiation should be adjusted accordingly. This is the exact opposite of the usual procedure. The use of adjustable louver grilles at each inlet helps in making this adjustment, but it is often not possible to compensate in this way for leakage.

The consulting engineer would do well to urge the architect to include a clause in his specifications requiring that these shafts, if they are to be used as ducts, be made solid from top to bottom and that all openings for pipes be especially well sealed to reduce leakage to a minimum. Likewise, it would be well for the consulting engineer to specify good adjustable dampers for each inlet.

On another job, floor beams of the lattice type were used. The pipe shafts were made solid, to external appearance, from floor to ceiling, but the gaps between the ceiling and the floor slab above resulting from the use of this type of beam were not sealed off in any way. In every shaft at every floor there was a concealed break of about 6 in.

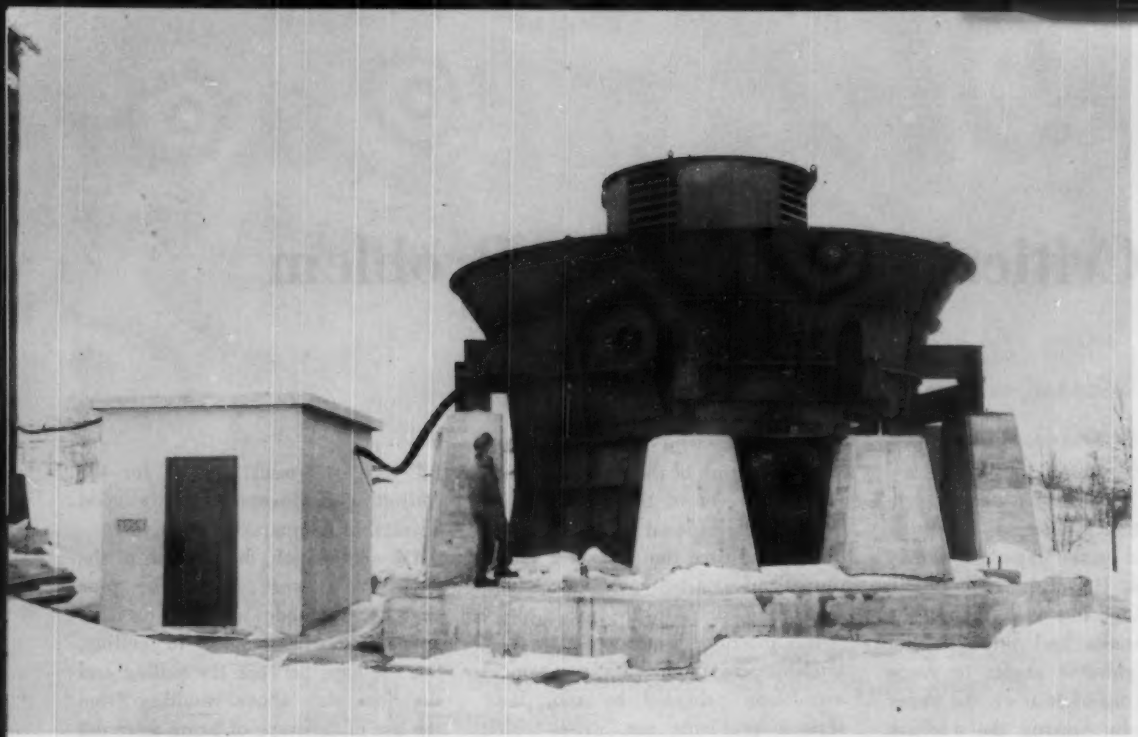
Not only was it impossible to balance the air flow, but the rush of air into these shafts was so great that the fans could not take care of it and the air was spilling out of the inlets on the upper floors. The condition was so bad that when someone on the lower floors fried onions, the people on the upper floors got the full benefit.

The only way to correct this was to remove the bathroom medicine cabinets so that a man could get inside the shafts and plaster over the gaps. This was a tedious and expensive operation.

The solution, of course, is to install sheet metal ducts inside the pipe shafts in the first place. These ducts not only can be made tight but their cross sections can be adjusted to the volume of air to be handled, thereby facilitating easy balancing — especially if the inlets are fitted with adjustable dampers.

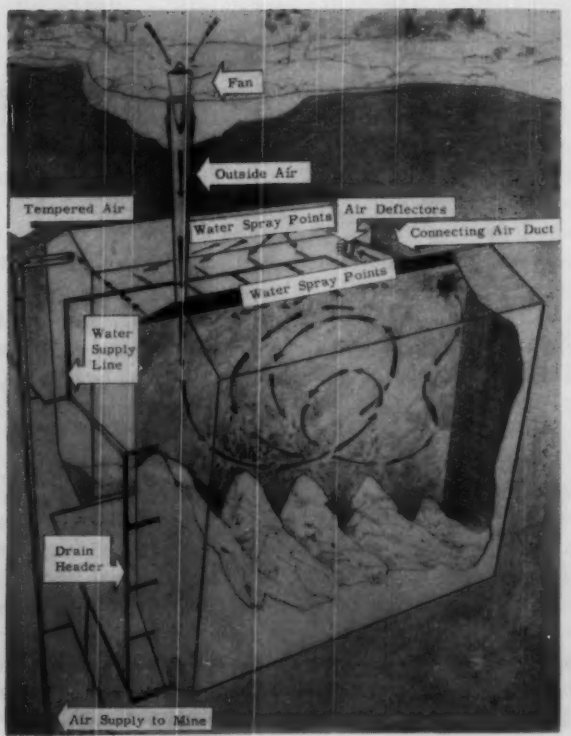
With such an installation there is no need to worry much about stack effect and, unless the exposure is very bad, there is no necessity for increasing radiation on upper floors.

Unfortunately, it is the cost of these ducts which leads some builders to cut corners and not include them in their installations. ⧺



GIANT FAN — 198 in. in diameter, vertical propeller type and one of the largest in the world — pulls in up to 750,000 cfm of outdoor air to ventilate mine workings 600 ft below surface. Fan is driven by 650 hp motor. Impeller mounted directly on motor shaft has 12 adjustable pitch blades

Ice Warms, Cools Mine Ventilation Air



UNDERGROUND AIR CONDITIONER reverses heating-cooling cycle in summer and winter. Surface fan supplies outside air which is circulated through cavernous stopes on its way to main intake. Water from melting ice drains to mine pumping system through riser with inlets at 25 ft intervals

HUGE ICE CONES form in winter at bottoms of two 200 ft high ice stopes when water is sprayed into incoming outside air. Over 140,000 tons can be formed at full capacity of 750,000 cfm of air. Freezing process releases heat, raising air temperature as low as −57 F (outside surface) to 27 to 30 F at main intake 600 ft below

A UNIQUE air conditioning system that raises the temperature of cold air in the winter by making ice and using the ice to reduce the temperature in the summer serves the International Nickel Co.'s Frood-Stobie mine in the Sudbury district of Ontario, Canada.

Since heat is released when ice is formed, ice production takes the chill from outside air supplied from the surface to the mine workings.

The fan that delivers the air to underground has a diameter of 198 in. and is one of the largest in the world. This fan, which has a top capacity of 750,000 cfm, blows air from the surface through a 300 ft vertical airway 20 ft in diameter into two huge open stopes mined by the blasthole method for this purpose between the 300 and 500 ft elevations. Each stope is 80 ft wide × 200 ft long × 200 ft high. The stopes are separated by a pillar 70 ft wide. The air circulates through the two stopes in succession on its way to the main intake.

Water from the mine's main pumping system is furnished at 120 psi to the four spray points at the top of each stope. The volume of water required in winter months varies up to 200 gpm. The fine particles of water sprayed into the air passing through the stopes turn to ice, and the heat given up in the process is transferred to the air. Some 40,000 tons of ice were formed at the bottom of the stopes one winter. This heat, along with that absorbed by the air from the large area of wall rock exposed in the stopes, added up to 15 billion Btu.

Although the surface temperature during the winter ranged to −57 F the outside air delivered from the main intake of the mine ventilation system 600 ft below surface varied only between 27 and 30 F as a result of its side trip through the ice stopes. The temperature eventually is expected to be held at about 32 F as the system is improved.

When the volume of air handled through the system reaches full capacity of 750,000 cfm, as compared to 150,000 to 300,000 cfm during the first winter, upwards of 140,000 tons of ice can be formed in the stopes during each winter.

In the summer the ice is melted as the warm outside air passes through the stopes, and the air is cooled between 5 and 10 F. The humidity of the outside air also is reduced as it is cooled below the dewpoint temperature and much of its moisture drops in the stopes.

At other mines where heating of outside air is required in winter, steam or oil installations are used. When the Stobie operation was being planned and it was noted that the logical position for the main outside air intake was near a low grade section of the ore body conveniently between the two main mining areas, the feasibility of establishing ice stopes presented itself. As a result, Stobie has been equipped with an efficient air conditioning system at a fraction of the cost of a surface heating plant. ∓

Sam Lewis' Page

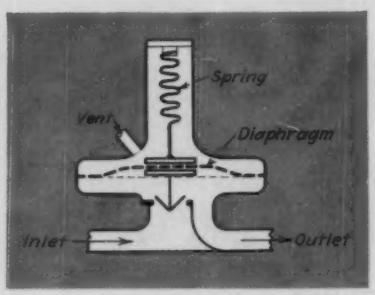
Breather Pipe to Outdoors Vents Valve Air Pocket

. . . to keep diaphragm valve operating when handling low pressure gas

A UNIQUE feature of liquefied petroleum gas is that it can be transported to its point of use as a liquid and changed to gas as pressure is relaxed and heat is gained.

The change of state from liquid to gas is accomplished through the use of a specialized valve which closes under spring pressure. The valve stem is attached to a diaphragm made of fabric. The spring must be strong enough to close the valve against the gas pressure at the valve inlet. This pressure, of course, tends to open the valve.

If a low gas pressure is desired at the outlet from the valve, it is necessary to compress the spring by pushing the diaphragm up to open the valve. We thus get low pressure gas.



A gas chamber under the diaphragm is in close communication with the low pressure outlet from the valve. The spring and the reduced pressure under the diaphragm work against each other and control the valve.

Ultimately, the gas pressure in the outlet may be as little as 8 oz. This low pressure below the diaphragm may no longer keep the spring from closing the valve. The valve must again be opened, and to do so the diaphragm must rise. This cycle of tendency to close against tendency to open goes on indefinitely.

A control diaphragm on a steam pressure valve of this type usually has water or condensate against it. This protects the diaphragm fabric from deterioration due to heat. When the pressure of the gas must be regulated, however, the low pressure gas below the diaphragm need not deteriorate the diaphragm when it forces the latter up against the spring. The equipment may serve acceptably under this condition.

If the diaphragm should experience fatigue, the gas could leak into the chamber above it. A corrective measure that can be taken in this situation is the connection of a vent or breather pipe from the chamber to the outdoors.

Recently I was consulted on a case of this type. The problem was that the burner in question was not receiving enough gas and was therefore suffering repeated flame failures.

An investigation revealed that the breather pipe to the outdoors had become constricted. As a result, the diaphragm could not lift the valve against the resistance of the spring, plus the pressure of the unvented air pocket above the diaphragm. The flame failed for want of gas.

Questions in the owner's mind that the gas piping was undersized, that the gas was not the right kind, or that I had made some other terrible mistake, were all squelched as soon as the condition of the breather pipe was corrected. ≠

SAMUEL R. LEWIS, *consulting mechanical engineer and a member of Heating, Piping & Air Conditioning's board of consulting and contributing editors, comments informally each month on practical problems in the field.*

Addresses of Engineering Societies, Associations

Acoustical Society of America, 335 E. 45th St., New York 17.

Air Conditioning Blower Manufacturers Association, 2300 Payne Ave., Cleveland 14.

Air-Conditioning and Refrigeration Institute, 1346 Connecticut Ave., N.W., Washington 6, D. C.

Air-Conditioning and Refrigeration Wholesalers, 1200 W. Fifth Ave., Columbus 12, O.

Air Cooling Institute, P.O. Box 2121, Wichita Falls, Tex.

Air Distribution Institute, 2130 Keith Bldg., Cleveland 15.

Air Filter Institute, 300 Independence Ave., S.E., Washington 3, D. C.

Air Moving and Conditioning Association, Inc., 2159 Guardian Bldg., Detroit 26.

Air Pollution Control Association, 4400 Fifth Ave., Pittsburgh 13.

Air Pollution Foundation, 2556 Mission St., San Marino, Calif.

Aluminum Association, 420 Lexington Ave., New York 17.

American Foundrymen's Society, Golf and Wolf Rds., Des Plaines, Ill.

American Gas Association, 420 Lexington Ave., New York 17.

American Industrial Hygiene Association, 14125 Prevost, Detroit 27.

American Institute of Architects, 1735 New York Ave., Washington 6, D. C.

American Institute of Electrical Engineers, 33 W. 39th St., New York 18.

American Institute of Supply Associations, Inc., 402 Albee Bldg., Washington, D. C.

American Nuclear Society, John Crerar Library, 86 E. Randolph St., Chicago.

American Society of Agricultural Engineers, 420 Main St., St. Joseph, Mich.

American Society for Engineering Education, University of Illinois, Urbana, Ill.

American Society of Heating and Air-Conditioning Engineers, Inc., 62 Worth St., New York 13.

American Society of Heating and Air-Conditioning Engineers Research Laboratory, 7218 Euclid Ave., Cleveland 3.

American Society of Mechanical Engineers, 29 W. 39th St., New York 18.

American Society of Refrigerating Engineers, 234 Fifth Ave., New York 1.

American Society of Safety Engineers, 425 N. Michigan Ave., Chicago 11.

American Society for Testing Materials, 1916 Race St., Philadelphia 3.

American Standards Association, 70 E. 45th St., New York.

American Welding Society, Inc., 33 W. 39th St., New York 18.

Anthracite Institute, 237 Old River Rd., Wilkes-Barre, Pa.

Association for Applied Solar Energy, Suite 202, Central Plaza Bldg., Phoenix, Ariz.

Atomic Industrial Forum, Inc., 3 E. 54th St., New York 22.

Better Heating-Cooling Council, 250 Park Ave., New York 17.

Bituminous Coal Institute, Southern Bldg., 15th and H Sts., Washington 5, D. C.

Bituminous Coal Research, Inc., 121 Meyran Ave. at Forbes St., Pittsburgh 13.

Boiler and Air Conditioning Manufacturers Association, 54 Clarendon Dr., Valley Stream, N. Y.

Building Research Advisory Board, and Building Research Institute, National Academy of Sciences-National Research Council, 2101 Constitution Ave., N.W., Washington 25, D. C.

Code for Pressure Piping, ASA Sectional Committee B 31, Room 647, 420 Lexington Ave., New York 17.

Committee on Steel Pipe Research, American Iron and Steel Institute, 150 E. 42nd St., New York 17.

Compressed Air & Gas Institute, 122 E. 42nd St., New York 17.

Cooling Tower Institute, 420 Emerson St., Palo Alto, Calif.

Copper and Brass Research Association, 420 Lexington Ave., New York 17.

Diamond Core Drill Manufacturers Association, 122 E. 42nd St., New York 17.

Edison Electric Institute, 750 Third Ave., New York.

Electrical Institute of Washington, Pepco Bldg., 10th and E Streets, N.W., Washington 4, D. C.

Environmental Equipment Institute, 9 Spring St., Princeton, N.J.

Fire Equipment Manufacturers Association, Suite 759, One Gateway Center, Pittsburgh 22.

Fluid Controls Institute, Inc., P. O. Box 191, Decatur, Ill.

Formed Steel Tube Institute, 850 Hanna Bldg., Cleveland 15.

Fuel Oil & Water Heater Manufacturer's Association, P.O. Box 151, East Greenwich, R.I.

Gas Appliance Manufacturer's Association, 60 E. 42nd St., New York 17.

Heat Exchange Institute, 122 E. 42nd St., New York 17.

Heating and Cooling Coil Manufacturers Association, 2159 Guardian Bldg., Detroit 26.

Humidifier Association, 20211 Harvard Ave., Cleveland 22.

(Continued on next page)

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Hydraulic Institute, 122 East 42nd St., New York 17.

Industrial Heating Equipment Association, 1145 19th, N. W., Washington 6, D.C.

Industrial Mineral Fiber Institute, Inc., 441 Lexington Ave., New York 17.

Industrial Unit Heater Association, 2159 Guardian Bldg., Detroit 26.

Institute of Boiler and Radiator Manufacturers, Room 408, 608 Fifth Ave., New York 20.

Institute of Environmental Engineers, 9 Spring St., Princeton, N. J.

Institute of Heating & Air Conditioning Industries, Inc., 1254 W. Manchester Ave., Los Angeles 44.

Institution of Heating and Ventilating Engineers, 49 Cadogan Sq., London, S. W. 1, England.

Instrument Society of America, Granite Bldg., 313 Sixth Ave., Pittsburgh 22.

Insulation Board Institute, 111 W. Washington St., Chicago 2.

Insulation Distributor-Contractors National Association, 1632 K St., N.W., Washington 6, D. C.

Liquefied Petroleum Gas Association, 11 S. LaSalle St., Chicago 3.

Magnesia-Silica Insulation Manufacturers Association, 1317 F St., N.W., Washington 4, D. C.

Manufacturers' Standardization Society of the Valve & Fittings Industry, 420 Lexington Ave., New York 17.

Mechanical Contractors Association of America (formerly Heating, Piping & Air Conditioning Contractors National Association), Suite 570, 45 Rockefeller Plaza, New York 20.

Modular Building Standards Association, 2029 K St., N. W., Washington 6, D. C.

National Association of Building Owners and Managers, 134 S. LaSalle St., Chicago 3.

National Association of Corrosion Engineers, 1061 M & M Bldg., Houston 2.

National Association of Fan Manufacturers, Inc., 2159 Guardian Bldg., Detroit 26.

National Association of Power Engineers, Inc., 176 W. Adams St., Chicago.

National Association of Practical Refrigerating Engineers, 435 N. Waller Ave., Chicago 44.

National Board of Fire Underwriters, 85 John St., New York 38.

National Bureau of Standards, Washington 25, D. C.

National Certified Pipe Welding Bureau, Suite 570, 45 Rockefeller Plaza, New York 20.

National District Heating Association, 827 N. Euclid Ave., Pittsburgh 6.

National Electrical Manufacturers Association, 155 E. 44th St., New York 17.

National Fire Protection Association, 60 Batterymarch St., Boston.

National Heating & Airconditioning Wholesalers, Inc., 1200 W. Fifth Ave., Columbus 12, O.

National Heating & Cooling Sales Association, Inc., 50 Commerce St., Newark 2, N.J.

National Mineral Wool Association, 2906 Americas Bldg., Rockefeller Center, New York 20.

National Safety Council, 425 N. Michigan Ave., Chicago 11.

National Society of Professional Engineers, 2029 K St., N.W., Washington 6, D. C.

National Swimming Pool Institute, Harvard State Bank Bldg., Harvard, Ill.

National Warm Air Heating and Air Conditioning Association, 640 Engineers Bldg., Cleveland 14.

Oil-Heat Institute of America, Inc., 500 Fifth Ave., New York 36.

Pipe Fabrication Institute, Room 759, One Gateway Center, Pittsburgh 22.

Plumbing-Heating-Cooling Information Bureau, 35 E. Wacker Dr., Chicago 1.

Power Fan Manufacturers' Association, 2159 Guardian Bldg., Detroit 26.

Producers' Council, Inc., 2029 K St., N.W., Washington 6, D. C.

Radiant Heating and Cooling Institute, Suite 318, 5657 Wilshire Blvd., Los Angeles 36.

Refrigeration and Air Conditioning Contractors Association-National, 10510 Park Ln., Cleveland 6.

Refrigeration Industry Safety Advisory Committee, 1346 Connecticut Ave., N. W., Washington 6, D. C.

Refrigeration Service Engineers Society, 433 N. Waller Ave., Chicago 44.

Refrigeration Trade Association of America, 3531 14th St., N. W., Washington 10, D. C.

Sheet Metal and Air Conditioning Contractors National Association, Inc., 170 Division St., Elgin, Ill.

Society of Automotive Engineers, 485 Lexington Ave., New York 17.

Society of the Plastics Industry, Inc., 250 Park Ave., New York 17.

Steam Heating Equipment Manufacturers Association, 5200 W. Clinton Ave., Milwaukee 18.

Steel Boiler Institute, Inc., 1308 Land Title Bldg., Philadelphia 10.

Stoker Manufacturers Association, 307 N. Michigan Ave., Chicago 1.

Sump Pump Manufacturers Association, Mills Bldg., Washington 6, D. C.

Tubular Exchanger Manufacturers Association, Inc., 53 Park Pl., New York.

Underwriters' Laboratories, Inc., 207 E. Ohio St., Chicago 11.

Uniform Boiler and Pressure Vessel Laws Society, Inc., 95 Liberty St., New York 6.

United Association of Journeymen & Apprentices of the Plumbing & Pipefitting Industry of the United States and Canada, United Association Bldg., 901 Massachusetts Ave., N. W., Washington 1, D. C.

Vertical Turbine Pump Association, 335 Rowan Bldg., 458 S. Spring St., Los Angeles 13. ‡

HEATING, PIPING & AIR CONDITIONING

JOURNAL SECTION

OF

AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS

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President's Message

Further Evaluation of ASHAE-*ASRE* Merger

Last month on this page, I suggested six factors which each individual member might consider in evaluating the Merger Plan. There are many other such factors and I am here suggesting a few more of them.

For example, consider the subject of the interests of the local groups. There is no intent to reduce or jeopardize the autonomy now enjoyed by the local chapters of ASHAE or the local sections of ASRE. The interests of the groups are taken into account in the Plan. In fact the Plan is expected to include alternate means of merging the local groups in order that local situations may be suitably handled. Not only does the Merger Plan contemplate taking adequate care of maintaining and encouraging existing local organizations, it is also a means of increasing the importance of such groups in the whole operation, for the greater number of people available for Society membership in localities where no groups now exist will provide opportunities for organization of additional local groups.

Then there is the factor of prestige to be considered. Prestige is itself difficult to evaluate, but a combined Society with a broader scope and an increased membership can be expected to be looked on with greater respect by other professional groups as well as by its own members. The merged society should better be able to sustain full and unquestioned leadership in covering professional engineering matters in Refrigeration, Heating, Air Conditioning and Ventilation. The plan contemplates maintaining the already great prestige of the two societies by providing for the preservation of their traditions and by scrupulously honoring existing obligations of each society. This would extend to implied obligations and existing traditions such as the progression of national officers. The plan provides for progression of the present officers of both societies.

Then there is the factor of common interests and overlapping activities. An example of overlapping is the code work now carried on by each society, while basic common interests cover such subjects as thermodynamics, heat transfer, insulation, piping and psychrometry. The Merger Plan presents an open invitation to eliminate overlaps and duplications of effort, and at the same time to foster and develop the common interests.

It is my hope that each member of ASHAE will give his most thoughtful attention to the many factors which the Merger Plan contains — both those which I have mentioned on this page and those which his own thinking will bring to his attention.

E. R. Queer

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A Water-Cooled Luminaire in a Panel-Air System

By W. F. Spiegel*, Philadelphia, Pa.

SUMMARY—The *cold light* is a fluorescent lighting fixture where water-cooled panels form the reflector and extensions of the luminaire. Data showing the heat transfer mechanisms and the performance of these luminaires operating as cooling panels in a suspended metal ceiling were obtained by carefully instrumented tests in an occupied area of a completed installation. It was found that when water at an average of 9 deg below room temperature is circulated through the *cold lights*, the equivalent of 100 percent of the energy supplied to the lights is transferred to the water. The amount increases as the water temperature is further depressed.

Energy balances indicate that the data are accurate within the range of good air-conditioning load analysis.

THE YEAR 1951 saw the practical realization of a new concept in panel cooling when a panel-air system was installed in the 200,000 sq ft Manufacturers Life Insurance Co. building in Toronto. This installation represented an economically favorable solution, and incorporates both lights and panels in 24 percent of the interior ceiling area.

The fundamental design of the system and the luminaires was the result of an extended series of investigations by Charles S. Leopold starting over a decade ago.

In spite of several pioneer installations in Europe about 1935, the practicability of large panel-cooling systems had been seriously questioned because of the danger of surface condensation. When using water temperatures sufficiently high to be *safe*, conventional methods of computing radiation and convection transfer resulted in such large required panel areas that the use of panels for cooling appeared to be uneconomical in most areas.

Starting in 1939, several papers were published[1,2,3] pointing out that building structures absorb a large fraction of the radiation from normal room lighting. Subsequently, Leopold described a series of experiments[4,5,6] showing that a cooled panel forming part of a room surface will absorb a certain quantity of short-wave radiation from artificial light or sunlight virtually independent of the panel surface temperature. In effect, a panel will absorb more heat than conventional grey body calculations indicate.

With a more elaborate understanding of panel performance, it became practical to design *safe* systems to absorb a part of the heat load in commercial buildings. In a large building, if the losses through the perimeter are counteracted, the interior requires cooling regardless of outside temperature. It has long appeared desirable to save building space by removing part of this heat through water tubing rather than air ducts. Several installations have been made using pipes embedded in the ceiling, and more recently, by attaching metal ceiling pans to coolant pipes.

Even when using the entire ceiling area, however, the problem of moisture and ventilation supply is usually met by introducing small amounts of dry air to the conditioned space. The drying is most frequently accomplished by refrigeration, and some cooling effect results as a by-product. The smallest amount of air which can be introduced to the space is determined either by the lowest economical dew-point of the air leaving the apparatus, or by the minimum requirement for odor and ventilation control. The actual heat pick-up by the air can be calculated knowing the temperature resulting from run-around or economizer coils. The remainder of the room cooling load is then assigned to the panels. Such combinations have been designated *Panel-Air Systems*.

If the bond between the coolant pipes and the panel can be made sufficiently secure to obtain only small temperature differences between coolant and panel surface, then the cooling load assigned to the panels can frequently be absorbed by individual panels taking up only a part of the ceiling area. To further increase the effect of the panels, they can be incorporated into the lighting fixtures to intercept radiant and conducted energy before it reaches the space. Fig. 1 shows a cut view of such a luminaire. The design of these luminaires has been described in detail[6] as has the installation in the building of the Manufacturers Life Insurance Co.[7,8].

The operation of the panel-air systems was found to be unique in several ways. Low air quantities eliminated drafts. The units lent themselves to a system of control where the regulators anticipate a condition the panels will have to meet, resulting in very small deviations of room temperature throughout the day. It was also observed that the temperature tolerance of the occupants is at least as good as with conventional methods of air distribution. It ap-

*Staff Engineer, Charles S. Leopold Engineers. Member of ASHAE.

[1]Exponent numerals refer to References.

For presentation at the Semi-Annual Meeting of the AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS, Minneapolis, Minn., June 1958.

peared that the panel-air system could take its place among conventional systems, and it became desirable to obtain accurate data on the effectiveness of the *cold light* in performing the function of cooling an occupied space.

Objective

To be generally useful, it was attempted to describe performance in the following ways:

1. By making accurate measurements of the amount of electrical input and the heat absorbed by water flowing through the luminaire.
2. By preparing an approximate energy accounting for a typical interior area, including components of the luminaire.
3. By presenting a tabulation of the temperatures in various locations of a test area.

The use of a reduced scale model would have been costly and impractical in this case. It was felt that good data from a completed installation would furnish the most valuable information. The results stated are from readings made with instruments approaching laboratory precision.

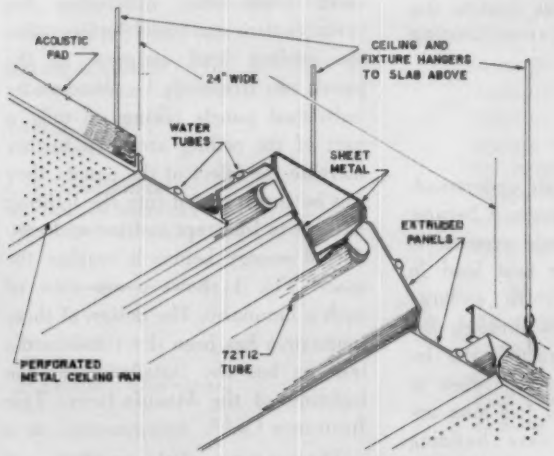

Fig. 1 — View of water-cooled luminaire

Theory of Investigation

It can be assumed that the amount of heat transferred to the water flowing through the luminaire has 2 major components: one constant quantity, independent of panel surface or water temperature, and one variable quantity.

The factor most influencing the variable component would logically be a function of the difference between the water temperature at any given location on the panel and the temperature of the surrounding air and surfaces, all integrated over the entire fixture area.

Any attempt to designate a *room-side* temperature which would be an index of radiation and convection, both in the upward and downward direction, is arbitrary unless the temperature of the ceiling space is known for various conditions. The finding of a *suitable roomside index* is considered as part of the problem, rather than an assumption. Whatever it should be, the effective temperature difference can be changed by varying the supply water temperature.

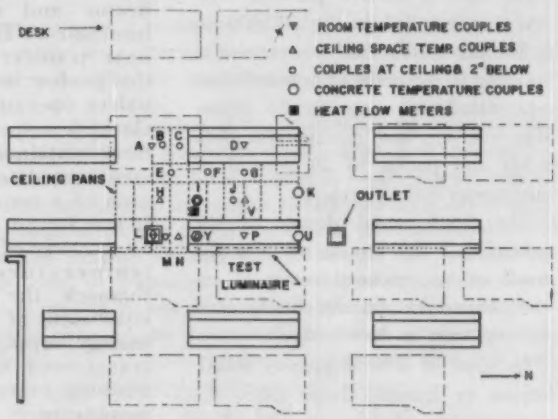

Fig. 2 — Part plan of 9th floor showing test area

The data for heat absorption by radiation from room surfaces and by natural convection were obtained by testing the fixture at night without light or air motion. This procedure eliminated effects from direct conduction, short-wave radiation, or forced convection. By similarly operating the fixture at night, but energizing the ballast and connecting the output leads to lamps in another area, the amount of heat conducted from the ballast to the water was reflected in the additional temperature rise of the water flowing through the fixture.

With the fluorescent tubes in operation and with air supplied from the diffusers, the following items contribute to the remainder of the heat absorbed by the water circulating through the luminaire:

1. Radiation by virtue of the difference between fluorescent tube surface temperature and panel surface temperature.

2. All other radiation from the fluorescent tubes striking the fixture.

3. Conduction from the tube sockets.

4. Radiation from other heated parts of the lighting fixture, such as the center pieces.

5. Increased convection resulting from the slightly warmer air in the open part of the fixture.

6. Forced convection component of heat transfer at the bottom side of the panel sections in the ceiling plane.

The radiation of the primarily short wave lengths from the fluorescent tubes should be constant. An inspection of the spectral distribution of this type of lamp shows that almost all the energy is in the visible and extremely short wave length region. A reproduction of the data given by the lamp manufacturer is shown as Fig. A-1 in the Appendix.* The radiation effect from such a tube would be generally similar to that emitted by a group of grey bodies at very high temperatures, and the radiation exchange would not be materially changed by a 10 deg change of a receiver near room temperature.

The variation in the other 5 items with a change in water temperature would be expected to be only small. The sum of the 6 items is thus defined as *Independent Transfer.* At the point of zero effective temperature difference, the independent transfer and direct conduction are at their minimum values and serve as an index of the effectiveness of the fixture design in intercepting the energy of the lighting at the source.

*It is planned to published the Appendix with the paper in TRANSACTIONS.

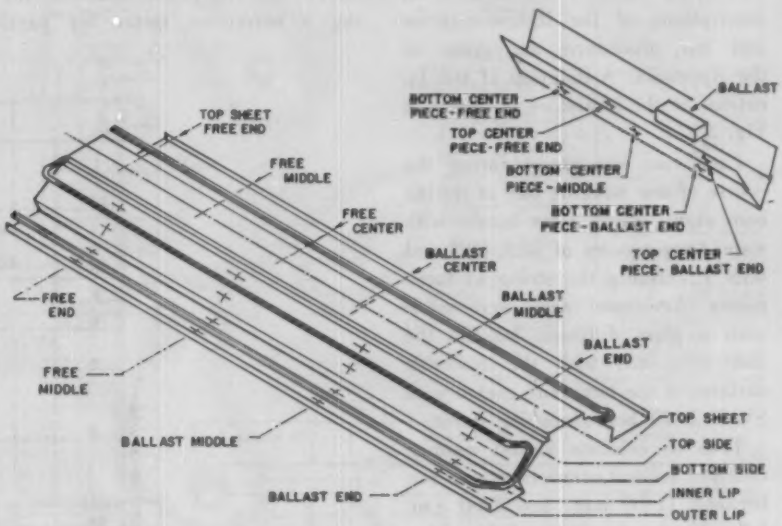

Fig. 3 — Luminaire test locations

Table 1 — Excerpt of logs covering Test G

PANEL WATER TEMPS — F	
Ent String 5 panels	62.26
Ent No. 5 test panel	65.43
Lvg String 5 panels	66.14
PANEL WATER FLOW—GPM	1.01
WATER TEMP DIFF (Pile)	
String of 5 panels	3.95
Test panel No. 5	0.73
SUPPLY AIR TEMPS	
At trunk duct	67.98
At outlet	69.23
ROOM TEMPERATURES	
Floor Surface at D	74.6
0′-2″ above floor @ D	74.27
0′-6″ above floor @ D	74.36
5′-0″ above floor @ D	74.36
0′-6″ below clg @ D	74.6
0′-2″ below clg @ D	74.6
Avg. Temp. 5′ (A,D,L,P)	74.40
AIR TEMP IN LIGHT TROUGH	
Temp at ballast end	80.5
Temp at other end	76.65
CEILING SPACE TEMPERATURES	
Bet. acoustic & pan @ J	74.9
Top of acoustic @ V	73.92
Center clg. space @ V	
0′-2″ below slab @ V	74.98
Avg temp ctr clg space	74.44
TEMPERATURE BELOW CEILING	
0′-2″ below clg @ B	74.6
0′-2″ below clg @ C	74.77
0′-2″ below clg @ E	74.36
0′-2″ below clg @ F	74.27
0′-2″ below clg @ G	74.27
0′-2″ below clg @ I	73.93
0′-2″ below clg @ J	74.27
0′-2″ below clg @ N	73.54
PSYCHROMETER READINGS	
Test space DB	74.9
Test space WB	56.5
Outside air (Weath Bur)	41.0
VARIATION DURING TEST	
Recorder-DB-F	1.0
Recorder-RH-%	2.0
LIGHT FIXTURE TEMPS	
Outer lip - free middle	69.23
Inner lip - free middle	69.47
Bottom side - free mid.	70.14
Top side - free middle	71.43
Top sheet - free center	77.07
Top ctr pc - free end	77.97
Bottom ctr middle	80.73
FLUO TUBE SURF. TEMP	
West tube - free end	87.0
West tube - bal. end	88.0
ELECTRICAL READINGS	
Ballast volts	123
Ballast watts	107.8
Tube amps - west	
Tube volts - west	185
LIGHT METER READINGS	
3′-0″ ab fl @ A(FC)	33
3′-0″ ab fl @ D(FC)	39
METAL CLG PAN SURF. TEMP	
At location B	74.9
At location C	75.25
At location E	75.07
At location F	74.8
At location G	74.85
At location I	74.6
At location J	74.85
At location N	71.4
CONCRETE SLAB TEMPS	
Avg clg top surf.	74.57
Avg clg mid. plane	74.63
Avg clg bot surf.	
Floor top surf. @ Y	74.72
Floor mid. plane @ Y	74.67
Floor bot surf. @ Y	73.55
PERIMETER SLAB TEMP	
Clg mid pl @ W wall	71.1
Clg bot sf @ W wall	72.34
HEAT FLOW METER DATA	
At clg-Btu/hr-sq ft	−0.71
Clg meter temperature	75.0
At fl-Btu/hr-sq ft	0.78
Floor meter temp.	75.3
(Neg value is heat out)	

Field Test

The actual test was conducted in a general office area on the 9th floor of the Manufacturers Life Insurance Company Building in a section toward the interior of the structure.

A string of 5 luminaire fixtures was choosen for the test, with the last one selected for detailed examination. A large number of measurements were made around the area of this fixture to provide a statistical survey of local heat exchanges.

Thermocouples were installed in the room and ceiling space at various heights, at locations 2 in. below the ceiling, at the metal ceiling pans, on the luminaire itself, in water wells, at the supply ducts, and at various planes in the concrete floor and ceil-

ing slabs. Heat flow meters were installed at the floor and ceiling slab surfaces, and a radiometer fixture was devised to measure the radiation emitted from the luminaire troffer. The general arrangement of the luminaire fixtures, air outlets, and test locations is shown in Fig. 2. Detailed descriptions of the instrumentation and test procedures are given in the Appendix. A diagram of test locations at the luminaire is shown in Fig. 3.

Each *run* was made during the course of one working day or during one night. Tests were made with water temperatures of 58.9, 62.3 and 68.8 F entering the string of luminaires. Additional runs were made with a glass diffusing lens in the luminaire, and with the roomside surfaces of the luminaire coated with SW-H 3079 heat-absorbing paint.

Tests to evaluate ballast conduction and natural convection were run between 11:00 p.m. and 2:00 a.m. following the departure of the cleaning staff. These *dark* tests were run with 55.3, 63.9 and 69.3 F entering water temperatures.

A full tabulation of 173 items for 9 runs is given in the Appendix as Table A-1. An excerpt of approximately half the readings for one run is shown in Table 1.

Evaluation of Convection and Radiation Transfer

The heat transfer rate at each individual area was estimated by the local temperature difference, and the total transfer computed by algebraic addition.

Carroll concluded in 1948[9] that a variety of convection formulae are required to meet various applications in panel heating and cooling. Somewhat later the ASHAE Research Laboratory published a paper by Min and others[10] showing various data, including results from their own tests on a completely instrumented environmental room and stating a correction factor for panel size. Another element of importance at low temperature differences is the effect of forced convection. This topic was investigated by Parmelee and Huebscher[11], who reported their results in terms of forced convection coefficients added to natural convection coefficients to obtain h values for total convection transfer. To illustrate the vast deviation possible with different formulae, 7 cases have been plotted in Fig. 4. Values at the lower temperature differences represent extrapolation.

The top line, which was adjusted for panel size and forced convection, is basically the data of Wilkes and Peterson[12], who pioneered in using large panels and small temperature differences, with air temperature measurements 2½ in. from the panels. Near the lower end of the band are the ASHAE data which have the advantage of relating to room size panels. They were calculated in terms of room temperature measured 5 ft above the floor. Actual cases show less difference between various formulae when values consistent with the respective test conditions are used. To calculate convection transfer for this experiment, the ASHAE

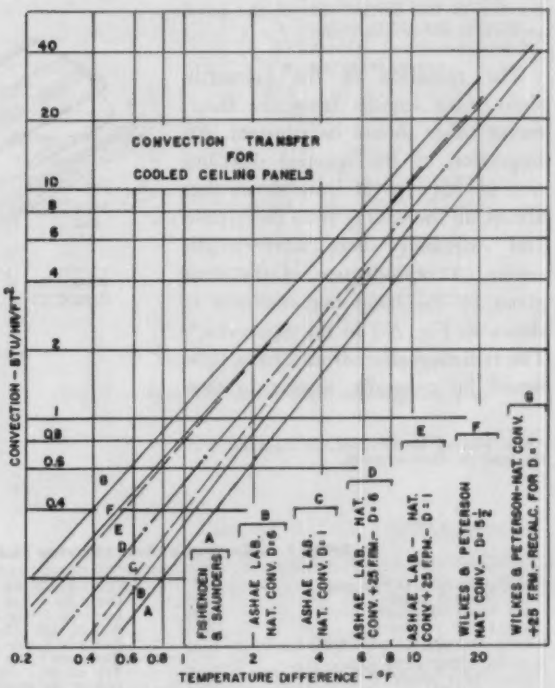

Fig. 4 — Convection from cooled ceiling panel (lower values extrapolated)

Table 2 — Excerpt of logs to determine effective temperature difference

TEST NO.	F	G	E	D	C	K
Condition of Test	LIGHT			DARK		
Water Temp Ent Panels	68.83	62.27	58.90	69.27	63.92	55.28
Supply Air Temp @ Outlet	64.06	69.23	68.82	—	—	—
Avg Floor Surf. Temp	74.04	74.62	73.02	72.85	73.25	71.86
Avg Bot Clg Slab Temp	74.22	74.58	73.46	73.84	74.10	72.31
Avg of Flr Surf. & Clg Slab	74.13	74.60	73.23	73.35	73.65	72.08
Avg Room Temperature	74.11	74.40	73.43	73.00	72.62	70.34
Avg Ceiling Space Temp	73.92	74.44	73.07	74.31	74.66	72.42
Avg Space Temp (Rm & Clg)	74.01	74.22	73.25	73.66	73.64	71.38

formulae were applied for the surfaces above the ceiling using average ceiling space temperatures. The transfer for the sloping sides was evaluated by other data of Wilkes and Peterson for inclined surfaces[12]. Downward convection was computed by the Wilkes data using the local air temperature and taking into account the measured velocity at each area.

The quantity of heat transferred from other room surfaces to the water-cooled luminaire was calculated by conventional methods as presented by Raber and Hutchinson[13], who give various charts for accurate estimation of shape factors.

Room Temperature Patterns

Temperature patterns for 3 of the test runs are given in Figs. 5 and 6. At the *normal* condition, there was only a very small variation in temperature from floor to ceiling. In several of the locations, reversals of minor convection currents are caused by larger radiation effects or forced convection.

The metal ceiling pans appear to absorb heat by radiation from the floor and other room surfaces, then lose it by convection to the ceiling space, at the same time losing energy to the room by convection. There is no evidence of any appreciable amount of heat flow transversely from the metal ceiling pans into the water-cooled panel extension of the luminaire.

Effective Temperature Difference

Because of the geometrically complex shape of the system, it is not practical to devise an empirical function to accurately relate several other variables to a true effective temperature difference. However, examination of the data leads to a practical index. Table 2 gives an excerpt of the readings.

The mean of the average ceiling space temperature (measured midway between the ceiling and the slab above) and the average room temperature (at the 5-ft level) should be a suitable parameter of the roomside index for the following reasons:

Table 3 — Heat balance on water-cooled luminaire
(*50 sq ft floor area per fixture*)

TEST DESIGNATION	F	G	E
HEAT REJECTED BY FIXTURE	Btu per Hour		
1. Top Surfaces — Convection & Radiation.	60.7	11.2	—
2. Center Pieces — Convection	11.5	13.0	17.2
3. Radiation fr. Opening to Room	62.0	50.0	43.0
4. Fluorescent Tube Convection	26.2	35.5	46.7
5. Heat Absorbed by Panel Water	199.0	370.5	420.0
TOTAL	359.4	482.2	526.9
HEAT ABSORBED BY FIXTURE			
1. Horizontal Panels — Convection & Radiation fr. Room	17.0	63.0	77.1
2. Top Surfaces — Convection & Radiation	—	—	15.3
3. Trough Faces — Roomside Convection	33.1	39.5	38.5
4. Electrical Energy	358.0	368.0	373.5
TOTAL	408.1	470.5	504.4
DIFFERENCE	48.7	11.7	22.5
% ERROR	10.1	2.4	4.5
AVG SPACE TEMP. MINUS AVG. WATER TEMP. — °F	3.06	8.64	10.37

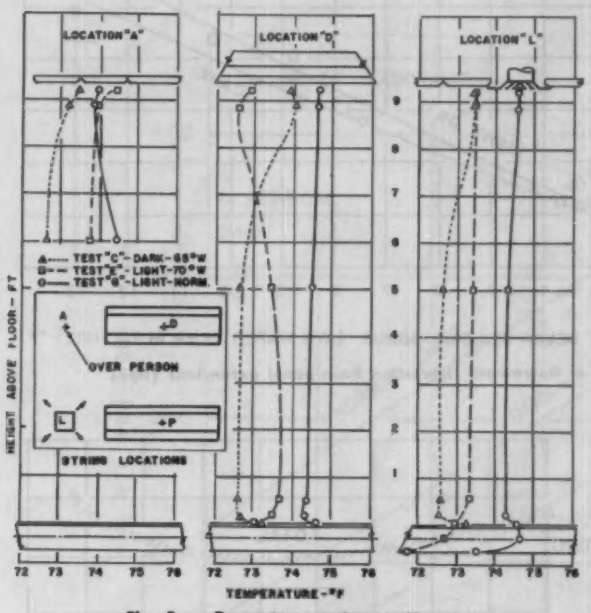

Fig. 5 — Room temperature patterns

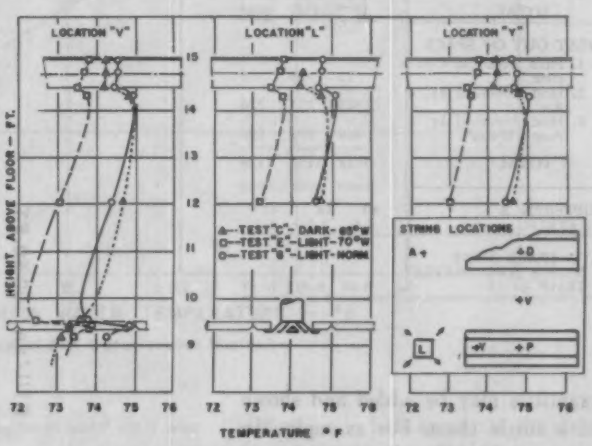

Fig. 6 — Ceiling space temperature patterns

1. It represents an average air temperature generally surrounding the luminaire.
2. It approaches (though it is not identical to) the average room temperature.
3. It approaches the average surface temperatures which the top and bottom of the luminaire *see*.
4. Its use resulted in good correlation of data.

Luminaire Performance

Since the effective temperature difference as previously defined is a significant parameter with respect to both radiation and convection, the 2 quantities may be added and shown on a single chart. For example, the heat transfer by radiation and convection from the top of the luminaire is shown as Fig. A-2 in the Appendix.

Table 4 — Heat balance on room module
(100 *sq ft, slab to slab*)

Test Designation	F	G	E
HEAT INTO SPACE —	Btu per Hour		
1. Electrical Energy	736	721	717
2. People @ 240 Btu Hr.	330	390	360
3. Office Machinery	11	11	11
TOTAL	1077	1122	1088
HEAT OUT OF SPACE			
1. Heat Stored in Concrete	51	39	6
2. Heat Absorbed by Air	513	253	226
3. Heat Absorbed by Panel Water	464	796	896
TOTAL	1028	1108	1128
DIFFERENCE	49	14	40
% ERROR	4.5	1.2	3.5
AVG SPACE TEMP MINUS AVG WATER TEMP — °F	3.06	8.64	10.37

Total convection and radiation quantities for the various parts of the fixture are shown in the form of a complete heat balance in Table 3. Calculations for the radiometer readings were completed only for Test G for net exchange through the luminaire opening. This result is intended to be an order of magnitude appraisal rather than an accurate figure. Precise radiation measurements of this nature in other than laboratory surroundings are extremely difficult. Test G was the only one where the full series of measurements could be carefully made without interruption. No significant change in high temperature radiation would be anticipated for the other tests. In order to estimate the change in low temperature radiation, the area weighted average surface temperature off all surfaces visible through the opening was computed and the radiation exchange calculated. Spot checks of individual readings from other tests show the adjustment to be approximately correct.

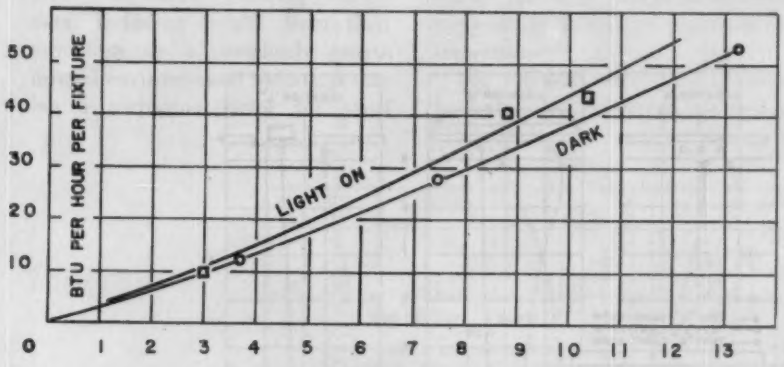

Fig. 7 — Downward convection from panel extensions (lips)

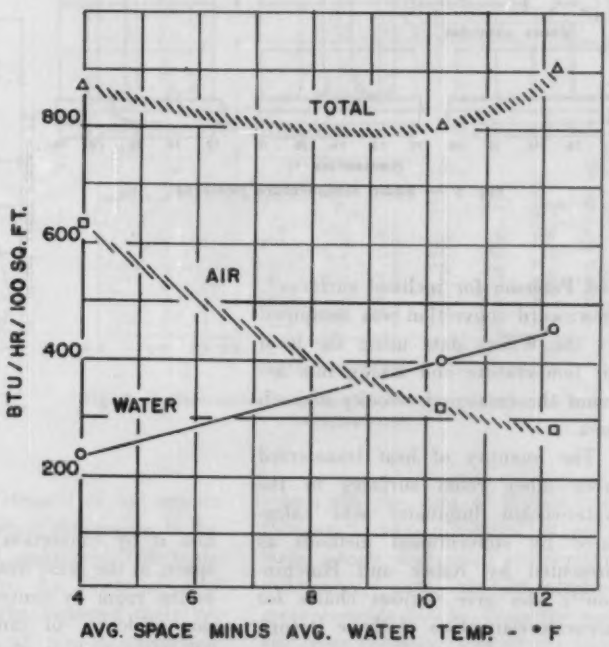

Fig. 8 — Heat pickup by panels and air

The downward transfer from the extended horizontal panels was not assumed to be a direct function of effective temperature difference since this transfer depends on the temperature of the air strata directly below the panel. The validity of measure-

ment at the 2-in.-below-the-ceiling level was verified by checking the gradient in the strata with a movable probe. The downward convection transfer from the panel extensions, or *lips*, to the room is shown as a function of the difference between average panel-water temperature and the average temperature 2 in. below the ceiling in Fig. 7. As the *dark* tests were run without supply air, the calculations for these tests do not include any forced convection component.

In this installation, there was a definite, though minor, difference between the temperature difference based on average space temperature and that based on 2 in. below the ceiling (the relation between the two can readily be plotted from the data). Greater variations might arise, depending on the quantity of air and type of distribution used.

Storage

The most consistent method for estimating heat input to the floor was found to be by the heat meter, which had a good bond to the floor surface. Heat flow into the overhead slab was estimated from readings of the buried thermocouples, as explained in the Appendix. The amount of flow into the slabs was small; the proximity of a person at times reversed the direction of flow. Such small magnitudes resulted in large percentage errors in these items.

An approximate energy accounting for a 100 sq ft area from slab to slab is presented in Table 4. This summary includes one air diffuser and 2 water-cooled luminaires. The heat gain from people was calculated from the average occupancy of 720 sq ft of area immediately surrounding the test fixture. The error in the balance is generally less than the value estimated for one person in the 720 sq ft. As expected, the amount of heat which can be assigned to storage, that is, the net difference in heat energy to the slabs, is extremely small. The relative pick-up by the panel and the air is graphically represented in Fig. 8.

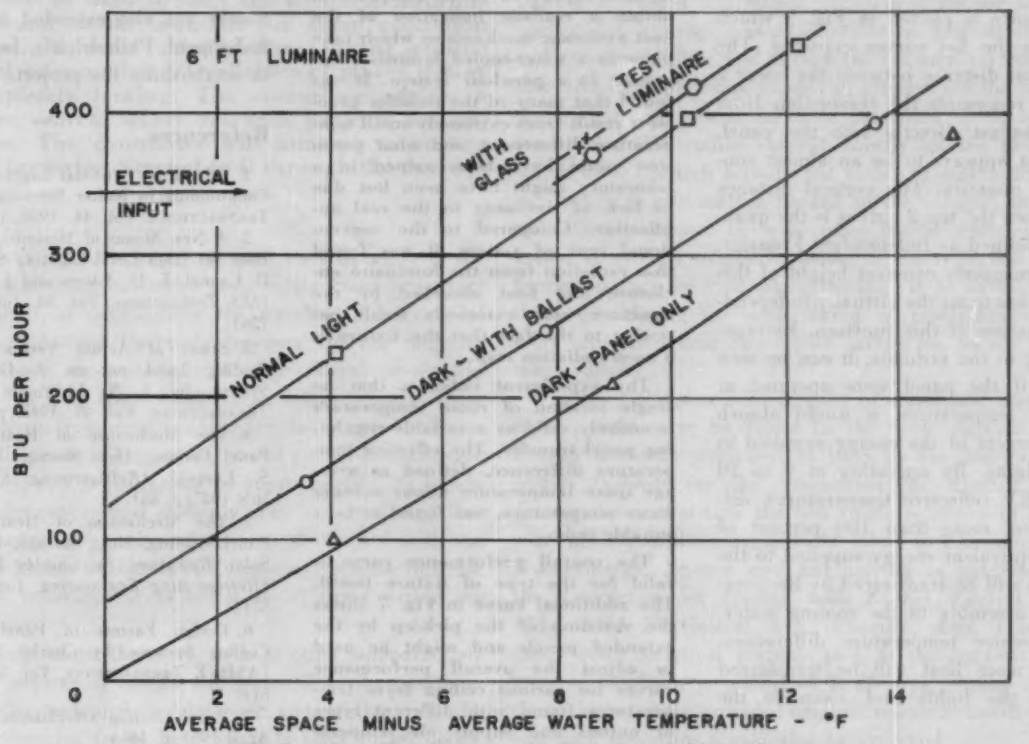

Fig. 9 — Overall performance of 6-ft water-cooled luminaire

Overall Performance

The conduction and independent transfer were adjusted for variation from design voltage. In assembling the data, the natural convection and room radiation curve was computed from the 4 fixtures preceding the fully instrumented test panel, all operating dark. The test unit, with only the ballast operating, furnished the points for the middle curve. The

normal operation data were taken from the average of 5 units, with the test unit shown separately. The test unit performance was slightly higher because it contained lamps which had operated a shorter time and because it was one of the fixtures in line with a diffuser. The overall performance is plotted in Fig. 9 which shows the flat curves expected. The vertical distance between the lower 2 lines represents the conduction from the ballast directly into the panel, and it appears to be an almost constant quantity. The vertical distance between the top 2 curves is the quantity defined as *Independent Transfer*. The relatively constant height of this band confirms the virtually independent nature of this function. Extrapolating to the ordinate, it can be seen that if the panel were operated at room temperature, it would absorb 35 percent of the energy supplied to the lights. By operating at 9 to 10 deg ET (effective temperature) difference, more than 100 percent of the equivalent energy supplied to the lights will be transferred by the complete assembly to the cooling water. At greater temperature differences, even more heat will be transferred from the lights and room to the water.

The results indicate that the heat-absorbing paint improved the characteristics only slightly, probably because re-reflections in the mouth-shaped luminaire troffer produced an initially high effective absorption, even with the regular paint. The addition of a glass lens tends to slightly increase the amount of heat pick-up by the water and might be used where desirable for lighting effect.

There was some question as to how the performance in the interior zone would actually vary from summer to winter. Examination of strip chart records of permanent concrete couples showed identical temperatures in the center of the slab in mid-August as in February when these tests were made. It had also been found that supply air and supply water temperatures to the interior zones had to be maintained substantially at the same control points summer and winter.

Conclusions

The basic instrumentation and methods appeared to be adequate to obtain a realistic indication of the heat exchange mechanisms which take place in a water-cooled luminaire operating in a panel-air system. It was found that many of the transfer processes result from extremely small temperature differences, and what precision could have been gained in a laboratory might have been lost due to lack of similarity to the real application. Compared to the conventional type of system, it was found that radiation from the luminaire enclosure and heat absorbed by the structure were extremely small, attesting to the fact that the fixture is a good *radiation trap*.

The experiment indicates that no single location of room temperature is entirely valid as a variable regulating panel transfer. The effective temperature difference, defined as average space temperature minus average water temperature, was found to be a suitable index.

The overall performance curve is valid for the type of fixture tested. The additional curve in Fig. 7 shows the variation of the pick-up by the extended panels and might be used to adjust the overall performance curves for various ceiling layer temperatures found with different types of outlets and supply air temperatures.

These data illustrate the type of heat transfer mechanisms that prevail in actual operation of a panel-air system and indicate the capability of specifically designed water-cooled luminaires to absorb the entire cooling load from lighting and do additional cooling as well.

Recalling the original objective, it would be practical, for example, to cool a 200 sq ft section of interior floor area of a normal general office space using 2 lines of ½ in. copper tubing (supply and return) and 2 runs of 4-½ in. round ducts conveying air at conventional velocities and pressure drop.

Acknowledgment

The author wishes to thank those who assisted in arranging for this field performance test. In particular, C. M. Humphreys and L. F. Schutrum, of the ASHAE Research Laboratory; W. Gordon and J. Y. Smith, Manufacturers Life Insurance Co.; C. L. Mulloy, Canadian Acceptance Corp., in whose area the test was conducted; and Professors Gulick and J. R. Anderson of the University of Pennsylvania. Special thanks are also extended to Charles S. Leopold, Philadelphia, for his help in establishing the project.

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Solar Energy Utilization for Heating, Cooling, Distillation and Drying

SUMMARY—The ASHAE Technical Advisory Committee on Solar Energy Utilization is interested in the development of basic and applied information pertinent to the use of solar energy for heating, cooling, distillation and drying. This discussion and decimal-divided outline, prepared by the committee, is intended to show broadly the technical information needed in the solution for solar utilization problems. In some classifications in the outline technical information is available; in others it may be completely lacking. The committee advises a literature search before research projects are undertaken. The committee will attempt to answer specific inquiries directed to it through the Society.

THE AVAILABILITY of energy and its adaptation to the accomplishing of useful ends is the most important single factor in determining the standards of living of peoples and nations. Currently, however, the vast majority of the energy resources utilized in producing power and heat are derived from fossil fuels. Unfortunately, these stored energy resources are limited in reserve and unequally distributed. The annual world energy consumption for all purposes is equivalent to approximately 38 billion tons of bituminous coal annually. Yet it is projected that the increasing population of the world coupled with the desire for higher standards of living may increase this rate of energy consumption as much as 50 times within the next century.

The world must, therefore, look to other comparatively untapped sources of energy and power if civilization is to continue its technical development and if the underdeveloped countries are to be brought to their fullest potential. Fortunately, two vast sources of energy remain virtually untapped, and their availability depends to a great extent upon steady technical progress as well as technological breakthroughs. One is the harnessing of fission and fusion processes and the other is the gathering and utilization of solar energy.

The uses to which solar energy are most likely to be put will vary between countries depending upon the energy availability and economic status. In countries such as Sweden and the United States the most likely initial uses appear to be in the field of space heating. In the warmer countries such as India and Israel the adaptation of solar energy to water heating, drying and refrigeration will be of great and probably initial importance. Solar energy developments in the fields of distillation and pumping are adaptable to many areas of the world where water must be purified and moved.

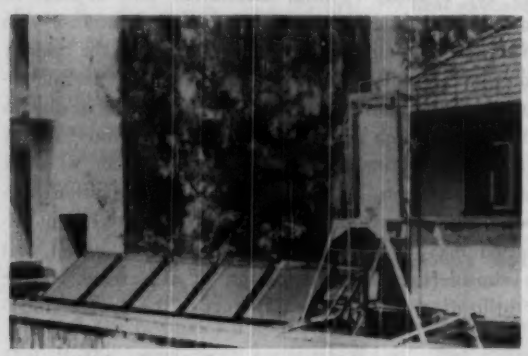
In 1955, in recognition of the potential importance of solar energy utilization to the members of the AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS, the Society formed a Technical Advisory Committee on Solar Energy Utilization. Because of the world-wide interest in this activity the committee was made international in scope with membership from Malay, Israel, Sweden and India as well as the United States and Canada. The scope of the committee was defined as the development of basic and applied information pertinent to the use of solar energy for heating, cooling, distillation and drying. In order to best outline and survey the research necessary in this field, the committee elected to prepare for the Society the outline and discussion here presented. It is not intended that this outline suggest directly specific problems which need research activity but rather to outline broadly the technical information needed in the solution of solar utilization problems. In some cases the information suggested is already available, while in others technical information may be completely lacking. It is advised that those considering the undertaking of researches in the solar utilization field thoroughly survey the source literature available.

The most complete bibliography of significant literature in this field is to be found in the book *Applied Solar Energy Research* published in 1955 by the *Stanford Research Institute* for the *Association for Applied Solar Energy*. Since that time the best single reference of recent solar utilization literature is to be found in *The Journal of Solar Energy, Science and Engineering* as published by the *Association for Applied Solar Energy*, Central Plaza Bldg, 3424 N. Central Ave., Phoenix, Ariz. However, many other technical journals such as the JOURNAL SECTION of the Society, published in *Heating, Piping & Air Conditioning*, have provided original research contributions and such literature should also be surveyed.

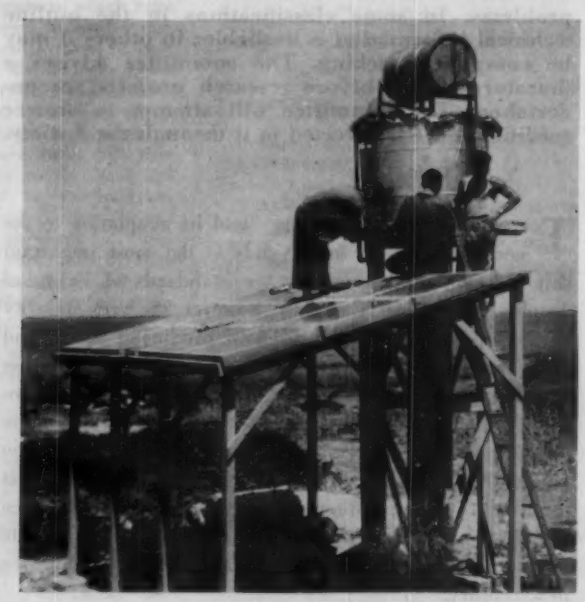
In the accompanying outline, Section 1—The Availability of Solar Radiation, Section 2—Solar Collectors and Section 3—Solar Heat Storage, are basic to all utilization problems. The solar source is a transient one, varying not only seasonally and geographically but also with such meteorological variables as cloud pattern, atmospheric contamination and atmospheric water vapor content. There is at present insufficient knowledge to permit even a statistical prediction of the availability of solar energy in most areas of the world. This is the starting point for all solar utilization problems.

This paper is a technical contribution made by the members of the Technical Advisory Committee on Solar Energy Utilization, who are its joint authors. They are: R. C. Jordan, USA, Chairman; F. R. Ellenberger, USA; M. L. Ghai, USA; H. C. Hottel, USA; N. B. Hutcheon, Canada; M. L. Khanna, India; G. O. G. Löf, USA; C. O. Mackey, USA; Gunnar Ploijel, Sweden; Maria Telkes, USA; J. L. Threlkeld, USA; G. T. Ward, Singapore; and L. F. Yissar, Israel.

Collection of solar energy is the next problem. Both moving and fixed collectors have obvious disadvantages. For high-temperature collection, concentrating devices are necessary, but for most low-temperature applications, plane collectors would appear to have dominant advantages. Potentially, improvements in collection either in cost or efficiency may be possible through such technical considerations as wavefront and wavelength discrimination, the use of translucent solar trapping materials other than glass, or through simplified combinations of collector surfaces and configurations or transport passages. In the final analysis, if collector systems can be constructed and maintained cheaply enough, a vast number of solar utilization devices become immediately practical.



Solar collector experiments in Singapore, Malaya



A custom built solar hot water heater in use in Israel as an example of the applications of solar energy which are being made in many parts of the world

The third area of basic consideration concerns solar heat storage. This again in final analysis is an economic problem. In some solar applications such as the pumping and distillation of water the end effect can be stored and thermal storage in itself is not necessary. However, in applications of solar energy to space heating and cooling, thermal storage becomes necessary, since spaces must be maintained at predetermined temperature levels rather than permitting them to be overheated or overcooled and provision made for continuous service during sunless hours.

Section 4—Architectural Considerations, involve those factors which must be taken into consideration when solar collectors and storage systems are to be integrated into architectural structures. For example in the heating and cooling of buildings micrometeorological variations and the obstructing effects of the surrounding terrain and of surrounding buildings must be thoroughly considered. In addition, the blending into a structure of the large surface areas required for solar collection, and the adaptation of a suitable solar heat storage system pose architectural challenges.

Once the availability of solar energy has been determined, efficient and economical collection and storage devices have been developed, and integration of the collectors and storage systems into the structures has been accomplished so as to provide an aesthetically pleasing appearance, then the problems of space heating and water heating with solar energy (Sections 5 and 6) are comparatively minor. There are, however, a number of variations in system design which must be considered for most effective operation. Whether solar energy is to be collected and utilized directly; whether it is preferable to reduce the size of collectors and to utilize intermediate energy lifts such as through heat pump systems; whether the systems should be designed with additional auxiliary heat; and whether or not the solar collection should be with air, water, or some other media as a transport agent are but some of these problems. In addition, domestic hot water heating may be combined with space heating or even cooling. An extension of the use of the solar system to the heating of swimming pools, perhaps both to extend the use of the pool beyond the normal seasons and also for adaptation of the swimming pool as a solar storage system, indicates additional possibilities.

Comparatively little effort to date has been placed upon the adaptation of solar energy to comfort cooling or to the low-temperature preservation of foods (Section 7—Cooling and Refrigeration). Inherently, such considerations have real appeal and practicality since those areas of the

world which have the highest solar availability also have the greater needs for cooling and refrigeration.

Concomitant with the rapid increases in world population and the increasing industrialization of the majority of the world's countries are also the burgeoning demands for pure water (Section 8—Distillation). There are few areas of the world which have sufficient pure water to supply the long-range needs when full consideration is given to the requirements of human consumption, agriculture, and industry. Again, the greatest potential needs appear to be in those sections of the world where the availability of solar energy is highest and the availability of potable water is lowest. The extension of agriculture and industry to arid or semi-arid areas depends greatly upon the water supply. Considerable progress has been made in the design of solar stills which utilize solar energy for the evaporation of brackish water and the subsequent condensation of pure water. Where such devices are practical the availability of solar energy is frequently favorable and with solar stills the problems of storage and architecture are minor. In most respects the problem resolves to the design and construction of an economical solar collection and distillation system. The costs of water obtained by standard means vary widely, and in some areas the use of solar distillation devices is imminently practical. There is no present indication, however, that solar evaporation can provide water from the sea for agricultural use at an economically interesting cost.

The problems of solar utilization for drying and concentrating (Section 9) have been only lightly explored. In the case of agricultural products such as vegetables and fruits, it is now impossible to consume the entire production at the time of the harvesting, and provisions must be made to avoid deterioration either by placing in cold storage or by drying. In the industrialized countries, facilities for cold storage are available, but in the industrially retarded countries these products are dried by direct exposure to sunshine. Such a process is both time-consuming and unhygienic. In places where fuel is scarce or in short supply and plenty of sunshine is available, solar energy could profitably be utilized and the drying time considerably reduced through the application of solar collection and heat transfer devices. The seasoning of wood, the drying of vegetables and fruits, and the preparation of common salt from sea water suggest other applications. Similarly, in such countries as India, cottage and small scale industries can concentrate palm and sugar cane juices directly into jaggery or thick syrup by the use of concentrators now under development.

It is hoped that these few comments together with the accompanying outline will be of aid in orienting the thinking of solar energy utilization problems and in the suggesting of fruitful areas for research. The Technical Advisory Committee on Solar Energy Utilization will attempt to answer specific inquiries directed to the committee through the Society in those cases where individuals or groups of individuals are planning to embark on an organized program of research in solar energy utilization.

Acknowledgment

Acknowledgment is made to those members of the Committee who have arranged for making available the photographs included here, *viz.*: R. C. Jordan, Minneapolis, Minn.; M. L. Khanna, New Delhi, India; J. L. Threlkeld, Minneapolis, Minn.; G. T. Ward, Singapore, Malaya; and L. F. Yissar, Israel.

Outline of Technical Information Needed for Solar Energy Utilization

Section 1—Availability of Solar Radiation

1.1 ***Availability during clear days***

1.11 Normal incidence

1.111 At various times of year

1.112 At various locations on earth's surface

1.12 Incidence of direct solar radiation upon variously oriented surfaces

1.121 Outside the atmosphere

1.122 At various locations on earth's surface

1.123 Hourly rates of incidence at various times of year

1.13 Diffuse radiation from sky

1.131 Incidence upon variously oriented surfaces

1.132 Variation of incidence with time of year

1.14 Diffuse radiation reflected from ground and other surfaces

1.141 Determination of ground cover reflectances

1.142 Effect of receiving surface orientation

1.15 Total radiation

1.151 At various locations on earth's surface

1.152 Hourly rates of incidence at various times of year

1.153 Effect of receiving surface orientation

1.154 Determination of design values of instantaneous radiation rates for various times of year and for variously orientated surfaces

1.2 ***Availability during all days***

1.21 Total solar radiation received

1.211 Average hourly rates for days with various percentages of possible sunshine

1.212 Average hourly, daily, weekly, and seasonal totals of direct and total radiation for various locations

1.213 Statistical distribution of clear, cloudy, and partly cloudy days for each month for various locations

CONTRIBUTED

1.214 Sequences of clear, partly cloudy, and cloudy days for various locations in combination with outdoor temperature

1.215 Statistical distribution of hours with various levels of total solar energy intensity, for various locations

Section 2—Solar Collectors

2.1 *Energy source*

2.11 Direct solar

2.12 Diffuse and direct solar

2.2 *Geometry of collector design*

2.21 Orientation relative to solar source

2.211 Fixed

2.212 Movable

2.2121 Rotation in one plane

2.2122 Rotation in two planes

2.2123 Seasonal adjustments

2.22 Solar concentration by lens focusing

2.23 Solar concentration by reflection

2.231 Reflection in two dimensions

2.2311 Parabolic trough (line focus), circular trough

2.2312 Truncated triangular trough (plane focus)

2.2313 Hybrid (earth, plaster, multiple mirrors, etc.)

2.232 Reflection in three dimensions

2.2321 Paraboloid (point focus), hemisphere

2.2322 Cone (line focus)

2.2323 Hybrid (earth, plaster, multiple mirrors, etc.)

2.233 Albedo

2.24 Plane collectors

2.241 Box

2.242 Flat plate

2.3 *Temperature level of collection*

2.31 High temperature (furnace)

2.32 Intermediate temperature (heat collection for processing and cooking, refrigeration, space heating and cooling, power)

2.33 Low temperature (space heating, water heating, heat pump-heat source)

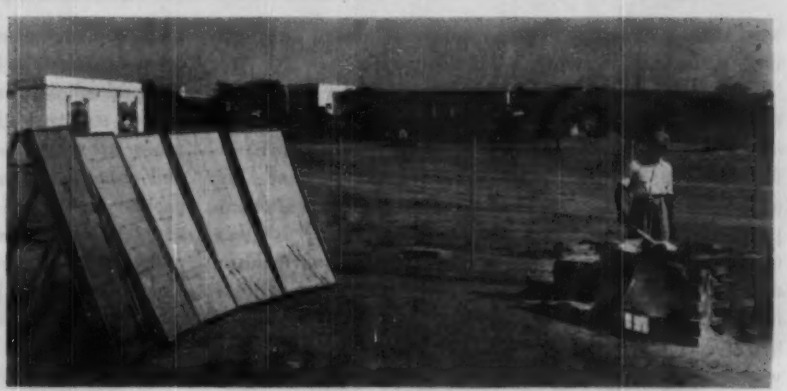
2.4 *Translucent solar trapping materials*

2.41 Material

2.411 Glass

2.412 Plastics

2.413 Other, *i.e.*, oil-film, chemical coatings



An example of the way solar energy is being applied — a plant for concentrating sugar juice in New Delhi, India

2.42 Radiation properties (reflectivity, absorptivity, transmissivity) for both solar and low temperature sources

2.43 Physical properties, *i.e.*, durability

2.44 Number of independent layers or traps (single, multiple)

2.5 *Absorbing surfaces*

2.51 Radiation properties

2.511 Emissivity (solar and low temperature)

2.512 Discrimination

2.5121 Wave length

2.5122 Wave front

2.52 Geometry

2.521 Relationship between transport medium and absorbing surface

2.5211 Medium contained in absorbing surface (double sheet, sheet and tube, etc.)

2.5212 Medium external to absorbing surfaces (gauze, parallel glass plates, etc.)

2.5213 Configuration of tubing or passages

2.6 *Reflecting surfaces*

2.61 Materials for specular layer

2.62 Materials for specular layer support

2.63 Materials for specular layer protection

2.64 Assembly methods

2.7 *Transport media*

2.71 Water

2.72 Air

2.73 Other

2.74 Multiple media

Section 3—Solar Heat storage

3.1 *Means of Storage*

3.11 Specific heat (rock, earth, water, etc.)

3.12 Solid-liquid phase change

3.13 Liquid-gas phase change

3.14 Reversible chemical reaction storage

3.2 *Container*

3.21 Type (tank, bin, earth, part of structure, etc.)

3.22 Location (above or below ground, in or out of structure, etc.)

3.23 Insulation

3.3 *Heat transfer*

3.31 Temperature level

3.32 Rate of heat accumulation and dissipation

3.33 Transfer areas, configuration

Section 4—Architectural Considerations

4.1 *Local conditions*

4.11 Obstructing effect of

4.111 Mountains, hills

4.112 Woods, trees, shrubs

4.113 Surrounding buildings

4.114 Neighborhood taste

4.12 Micrometeorological variations and cloudiness caused by

4.121 Mountains, hills and valleys

4.122 Nearby lakes

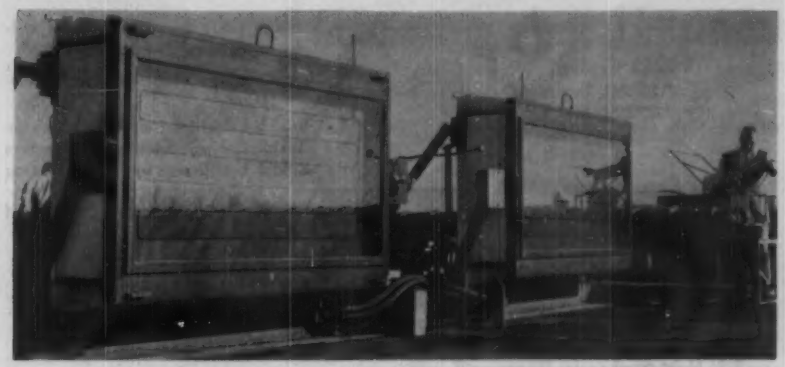
4.123 Obstacles surrounding the structure (trees, walls, etc.)

4.13 The ground

4.131 Level ground

4.132 Ground sloping in different directions

4.133 Nature of soil



Solar collector in use in University of Minnesota's solar program

4.2 ***Types of structures (homes, schools, stores, etc.) adaptable to solar heating and/or cooling, and their characteristics***

4.3 ***Windows***

4.31 Daily and yearly heat gains

4.311 Direct-solar with different orientation and inclination (single and multiple pane)

4.312 Reflection or albedo effects

4.313 Heat interchange due to temperature difference with different orientation and inclination (single and multiple pane)

4.32 Protection against direct-solar heat gain

4.321 External protection (overhangs, brise-soleils, awnings, shutters, trees, etc.)

4.322 Internal protection (venetian blinds, drapes, shades, etc.)

4.323 Protection between the panes (venetian blinds, shades, etc.)

4.33 Protection against heat gain or loss due to temperature difference

4.331 External protection (shutters, etc.)

4.332 Internal protection (shutters, drapes, shades, venetian blinds, etc.)

4.333 Protection between the panes (venetian blinds, shades, etc.)

4.34 Thermal properties of glass (transmissivity, reflectivity, absorbtivity)

4.4 ***Reception by walls and floors of solar heat through windows***

4.41 Effect of surface material

4.42 Effect of heat conduction by floor and wall material

4.43 Effect of heat capacity of floor and wall

4.5 ***Effect of roof and wall orientation on heat gain or loss***

4.51 Solar heat gain

4.511 Surface material

4.512 Surface color

4.513 Insulation properties

4.514 Ventilated surface construction (heat collector)

4.52 Heat gain and heat loss due to temperature difference

4.521 Insulation properties

4.522 Surface material

4.523 Ventilated surface construction (heat collector)

4.6 ***Optimum solar heat utilization with type and arrangement of structure***

4.61 Single family houses

4.62 Terrace houses (orientation of the row)

4.63 Apartment houses (arrangement of apartments, town planning)

4.64 Special houses (laundries, schools, etc.)

4.7 ***Integration of solar collector***

4.71 Location in building surfaces (roofs, walls, windows)

4.72 Separated collectors

4.721 Attached to building

4.722 Located near building

4.8 ***Integration of solar storage system***

4.81 Storage in building elements, (walls, floors, etc.)

4.82 Storage located inside building

4.83 Storage located external to building

Section 5—Space Heating

5.1 ***Architectural considerations (see Section 4)***

5.2 ***Collectors (see Section 2)***

5.3 ***Heat storage (see Section 3)***

5.4 ***Transport***

5.41 Water

5.411 Piping and insulation

5.412 Pump

5.413 Protection against freezing

5.414 Thermal expansion

5.415 Valves

5.42 Air

5.421 Ducts and insulation

5.422 Blower

5.423 Dampers

5.43 Low boiling point liquids

5.431 Pipe size

5.432 Low boiling point liquid flow control

5.433 Oil circulation

5.434 Valves

5.5 ***Energy conversion***

5.51 Collector transport medium same as fluid circulated for heat distribution

5.52 Secondary transport medium with heat exchange

5.53 Temperature lift with heat pump

5.6 ***Heat utilization***

5.61 Direct space heating transmitting radiation through windows, etc.

5.62 Indirect heating with separate collectors

5.7 ***System design***

5.71 Capacity requirements of structure

5.711 Maximum steady-stage heat loss of structure determining peak capacity

5.712 Transient heat loss under diurnal fluctuations

5.713 Sequence of weather conditions controlling insertion of heat into, or withdrawal from, storage and probable duration of supplementary heating if employed

5.72 Collector design (see Section 2)

5.73 Storage system design (see Section 3)

5.74 Heat distribution system design

5.75 Integration with solar cooling and domestic hot water

5.76 Flow chart of system

5.77 Control sequence and components

5.8 ***Solar heat for outdoor living***

5.81 Heating ground in garden place

5.82 Heating water in swimming pool

5.9 ***Economics***

5.91 Effects of different insulations (windows, walls, roof)

5.92 Effects of glass area to wall ratio

5.93 Effects of auxiliary heating

5.94 Solar heat source heat pump systems

Section 6—Domestic Water Heating

6.1 ***Requirements***

6.11 Peak load

6.12 Daily load

6.13 Source and discharge temperatures

6.2 ***System design***

6.21 Collector

6.22 Storage

6.23 Gravity versus forced circulation

6.24 Direct and indirect solar heating

6.25 Relationship to building design

6.26 Integration with solar space heating and/or cooling system

6.27 Auxiliary heat source

6.28 Controls

6.3 ***Collector design (see Section 2)***

6.4 ***Storage design (see Section 3)***

6.5 ***Economic factors***

Section 7—Cooling and Refrigeration

7.1 ***Design data***

7.11 Comfort air cooling

7.111 Minimum cooling requirements as a function of solar loads for various localities and for various types of structures

7.112 Unit loads *vs.* solar intensity for different localities

7.113 Distribution systems best suited to solar air cooling

7.1131 Lowering temperature of entering air

7.1132 Radiant cooling

7.1133 Evaporative coolers in conjunction with solar draft chimneys

7.12 Refrigeration design data

7.2 ***Refrigeration methods***

7.21 Mechanical compression

7.211 Solar power for driving conventional compressors

7.212 Solar (thermal) pumps adapted for refrigerant compression

7.22 Absorption and adsorption

7.221 Absorbate-absorbent combinations suitable for solar absorber temperature limits

7.222 Operation

7.2221 Continuous (circulation of boiling solution)

7.2222 Cycling

7.22221 Day-night

7.22222 Manual

7.22223 Governed by completed desorption

7.23 Expanding air

7.231 Solar (thermal) compressor

7.232 Solar hot air engine-turbine

7.24 Direct conversion of solar energy to refrigeration

7.241 Thermocouples

7.242 Semiconductors

7.3 ***Heat Sinks***

7.31 Conventional (*i.e.*, air, water, cooling, etc.)

7.32 Nocturnal radiation

7.4 ***Energy storage***

7.41 Storage of heat above ambient temperatures

7.42 Storage of refrigeration below ambient temperatures

7.43 Liquid refrigerant

7.5 ***Relationship of refrigeration method and box design***

Section 8—Distillation

8.1 ***General***

8.11 Potable water requirements at different locations

8.111 United States

8.112 World, land areas

8.113 Ships

8.114 Emergency rafts

8.12 Cost of potable water at different locations

8.121 Urban

8.122 Rural

8.123 Desert regions

8.124 Emergency

8.13 Rain or dew to supplement distilled water

8.131 Seasonal rainfall

8.132 Seasonal dew precipitation

8.14 Geographical areas where solar radiation can be used for distillation

8.141 For total water needs

8.142 With supplemental rainfall and dew collecting devices

8.2 ***Solar distillers with separate heat collectors***

8.21 Characteristics of collectors (see Section 2)

8.22 Evaporators

8.221 Single effect

8.222 Multiple effect

8.223 Flash-still

8.224 Jet-compression still

8.225 Optimum number of stages

8.226 Vapor compression still

8.3 ***Solar stills combining heat collection and evaporation***

8.31 Roof-type stills with tray evaporators

8.311 Effect of roof tilt and shape

8.312 Use of additional reflectors

8.313 Distilled water collecting channels

8.314 Construction of features and materials

8.32 Flat tilted solar stills

8.321 Effect of tilt

8.322 Porous evaporators

8.323 Rigid evaporators

8.324 Construction features and materials

8.33 Multiple effect solar stills

8.331 Effect of number of stages

8.332 Construction features and materials

8.4 ***Cost estimate of solar stills***

8.41 Initial investment costs

8.42 Site preparation and land cost

8.43 Operational costs

8.44 Comparison with other source costs

8.5 ***Special requirements of very small solar stills for remote areas (single families, domesticated animals, etc.)***

Section 9—Drying and Concentrating

9.1 ***Direct heating***

9.11 Direct exposure with natural convection and drying

9.111 Wind velocity, temperature and humidity of different instants and during different intervals

9.112 Properties of drying object (absorptivity, thermal diffusivity, vapor diffusivity)

9.12 Direct exposure with other aids to hasten drying

9.121 Use of glass and plastic films

9.122 Forced convection

9.123 Blackening of container

9.2 ***Indirect heating***

9.21 Medium air

9.211 Blowing air heated directly in a solar absorber

9.212 Blowing air heated by stored solar energy

9.3 ***Concentrating of dilute solutions***

9.31 Direct exposure with natural convection

9.32 Heating containers with energy concentrators(attached or separate)

9.33 Reactivation of sorbents

Heating by Hypocaust

By Edwin Daisley Thatcher*, New York, N. Y.

SUMMARY: Reports the results of a study of the five rooms heated by a hypocaust system in the Forum Baths at Ostia. Using modern knowledge and present-day weather data it is shown that the hypocaust could provide an environment comfortable to nude adult bathers in these rooms even though their large window openings were unglazed. Evidence points toward hypocaust system being an efficient and successful heating method, and that the ancients were aware of radiant heat both from surfaces and from the sun and made ingenious use of it to provide human comfort.

WHEREAS the ancient Roman method of heating by hypocaust has for years been correctly recognized as a form of radiant heating, it has also been mistakenly regarded as little more than a quaint archaeological curiosity. Recent investigations have shown it to have been not only a remarkably efficient system of heating for an era lacking the technological aids now taken for granted, but perhaps a more intelligently applied system than present day forms of radiant heating.

The Hypocaust Method of Heating

The heating medium of the hypocaust was the mixture of smoke, combustion gases and excess air from an open fire, and the hypocaust was essentially an apparatus for drawing off this mixture by natural draft. The apparatus was, in the main, horizontal, in the shape of a hollow floor. At one end of the hollow space was a hearth and at the other was a vertical flue, or flues. In its simplest form the hypocaust provided only a radiant floor. As it developed from its beginnings in the first century before Christ, the number of flues increased. This increment was in part designed to improve the distribution, by natural draft, of the heating mixture within the hollow floor, but when the flues were so multiplied that they covered one or more of the masonry walls of a room, they then provided supplementary radiant surfaces as well. Even the vaulted ceiling was eventually covered, so that a radiant casing was achieved.

The hollow floor was constructed of concrete on a base of 2-ft square, flat tiles supported on pillars of brick about 2 ft-6 in. high and spaced 2 ft on centers in both directions. The flues, when they acted only as draft inducers, were round terra cotta pipes from 8 to 12 in. in diameter. Those that lined the walls and also produced a radiant surface were of rectangular section. From a rather improvisatory beginning, when these were nothing more than roof tiles set with their flanges to the wall, they passed through several stages of development to their logical culmination as rectangular terra cotta tubes about 15 in. long with average interior dimensions of 3 × 4 in. These tubes were set side by side against the wall, from floor to ceiling, and held in place by mortar and T-shaped iron anchors driven between the tubes and into the masonry behind them. This whole lining was then covered by 4 to 5 in. of mortar, which was often veneered with 1 in. or more of marble. Fig. 1 shows a section through a typical hollow floor, as well as a plan of the wall lining.

When the lining of flues was not carried over the vault, it ended at the top of the wall in a horizontal collecting-channel leading to one or more small chimneys that either pierced the roof or ran up obliquely through the wall to its outside face. Exactly how the vault-linings were vented is still open to question because of the scarcity of intact lined vaults among the Roman remains, but there is little doubt that they were vented at or near the apex of the vault, and probably through a system of similar collecting-channels.

Development of wall- and vault-linings did not result in every heated room having a warm wall and ceiling. This development was reserved for those spaces requiring exceptional warmth, such as the hot rooms of baths, or the living rooms of dwellings in the colder provinces of the Empire. For, although the hypocaust system is most elaborately manifest in the great Imperial Baths, it was widely used for domestic heating in England, Germany and northern France, and even occasionally in Italy. The typical living room usually possessed only a warm floor, with perhaps a lined wall on the weather side. The hot rooms of baths, on the other hand, were jacketed with flues on all their walls and often on their vaults as well.

But in whatever form, the hypocaust provided the ideal means for

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achieving a condition of comfort in the typical enclosed space of Roman architecture: a high-ceilinged chamber, the volume of which was relatively large in comparison to its floor area. To heat the air volume of such a space would have been highly unpractical, and in the Imperial Baths the task would have been virtually impossible. The hypocaust system, instead, applied itself most directly to the basic condition for human comfort — the inhibition of human heat loss — by providing warm surfaces that inhibited this loss through its 2 broadest avenues: conduction and radiation. By inhibiting the loss in this manner, the system could concern itself only indirectly with the air temperature, or, in extension, with the loss through convection.

It is hardly safe to assume that the Romans had any idea, in the modern sense, of the physiological principles of human heat loss and heat generation, although it would not be too surprising had they had. There is no doubt, however, that they realized the efficacy of using radiant surfaces for comfort, because the development of the hypocaust system, which can be traced over a period of 600 years, shows an increasing awareness of this efficacy.

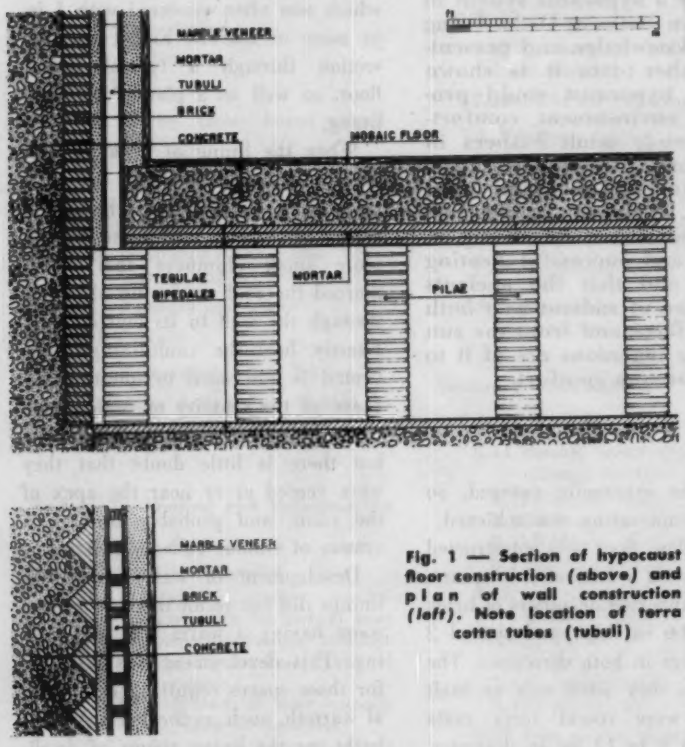

Fig. 1 — Section of hypocaust floor construction (above) and plan of wall construction (left). Note location of terra cotta tubes (tubuli)

The Forum Baths at Ostia

One of the most dramatic examples of the culmination of this development is to be found in the Forum Baths of the ancient port of Ostia, 15 miles down the Tiber from Rome. As their name implies, these baths lie next to the city's Forum, and were a principal bathing establishment of the community. They were erected in the middle of the second century after Christ and were in use throughout Constantine's time and for possibly 100 years thereafter, or until the barbarian invasions and the end of the Western Empire. They were, therefore, in operation for at least 2 centuries, and perhaps for 3.

The bath building itself is typical of most Roman thermal establishments only in its northern half, where the plan is symmetrically rectilinear. Along the southern facade, on the other hand, are 5 chambers of various design arranged in a stepped pattern that forms a seemingly whimsical contrast. The exterior walls of these 5 chambers, moreover, are almost completely taken up by great windows, and all the archaeological evidence points to their having been unglazed. Since these 5 chambers were the principal heated rooms of the baths, their open windows present a unique problem in both heating and orientation. The success of the solution is implicit in the building's use for over 200 years, but has been confirmed by an inquiry, in modern terms, into the functioning of the building and its heating system[1].

Although the Roman bath essentials are preserved in modern sweating rooms, massage rooms and cold plunges, the special character of the ancient establishments has been lost. These were not alone places in which to bathe; they were also the social centers of the community, where a whole day could be pleasantly spent in reading and gossiping, listening to poets and orators, politicizing and, perhaps only incidentally, in exercising and bathing.

A thorough cleansing was the chief end of the bathing; but the therapeutic benefits of steam, warmth and hot water were even then well recognized and were important secondary aims. A good bathing establishment was flexibly arranged so that the bather might follow his own rule. He would have begun by annointing himself. Then he would have started a sweat, either by exercise, by sunbathing, or by lounging about partially clothed in a warm room called a *tepidarium*. He might

then have gone into the high, dry heat of the *laconicum*, for a heavier sweat, or have passed directly into the *caldarium*, which was just as hot as the laconicum but, because of its pools of hot water, had a steamier atmosphere. Having sweated enough, he would have scraped off the oil, dirt and sweat with a *strigilis* and might then have soaked for a time in one of the hot pools. After this he could have cooled off slowly by returning to the tepidarium, or he might have taken the hardier course of a cold plunge in the tanks of the *frigidarium*. He could have had a massage before or after the climax in the caldarium, or he might have chosen the laconicum for his climax and finished off with only a cold douche. In any event, he would have favored the establishment that allowed him, with commodiousness, the greatest flexibility; and it is not difficult to understand that, from a purely technical point of view, this place would have had to operate efficiently.

The Forum Baths of Ostia would seem to have been a favored establishment: flexibly planned, commodious and efficient. The general plan of Fig. 2 shows the frigidarium (no. 21) as the center of the northern half of the building and as the focus for nearly all circulation into the hot rooms to the south. It contains 2 cold plunges (11 and 17) and is flanked by 4 *tepidaria* (10, 12, 16 and 18) of which the 2 southernmost are also vestibules into the hot rooms. East and west of this great hall are lounging rooms or libraries (9, 20, 19 and 13, 22, 15) and beyond them the entrance lobbies (8 and 14). The rooms forming the southern facade (1, 2, 3, 4 and 5) are those with great, unglazed windows, previously mentioned. No. 1 is a room for sunbathing — a *heliocaminus;* no. 2 is a laconicum; nos. 3 and 4 are a species of tepidarium; and no. 5 is the caldarium with 3 hot pools, the southernmost thrusting its semicircular window-wall out into the trapezoidal *palaestra*, the exercise yard. This sunny pleasance, a half-acre in area, is bounded on 3 sides by buildings with colonnaded porticoes, that contained shops, snack bars, a latrine, and rooms for lounging or entertainment. Room 6 is another laconicum, and Room 7 is the service area that contained the water heaters for the caldarium pools. From this room a low service passage runs all along the south front of the building, giving access to the hypocaust hearths of Rooms 5, 4, 3, 2 and 1. The vaulted roof of this passage projects several feet above the level of the palaestra and forms a kind of terrace. The more detailed drawings of Fig. 3 show the terrace in plan, as well as the passage in section.

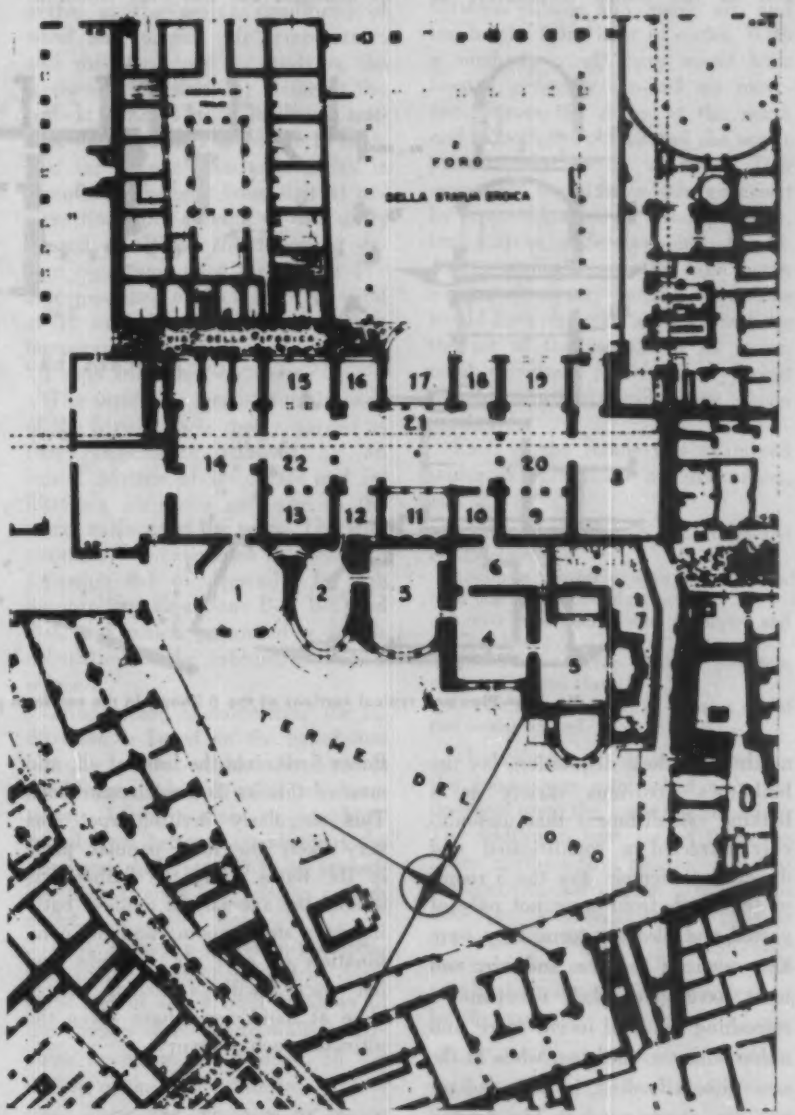

Fig. 2 — The Forum Baths (Terme del Foro) at Ostia and their surroundings

Study of the building's arrangement, with its provisions for various

intercommunication, reveals the flexibility of the planning. The skillful disposition of the rooms gave the bather a diversity of choice in his progress to and from the caldarium; and in the rooms themselves, as much as in their disposition, lay the building's luxurious variety as a bathing establishment that undoubtedly attracted a sophisticated and discerning clientele. For the 5 rooms of the south front were not only of varied and pleasing form, they were also open to the sun and air, and must have given their occupants a refreshing sense of lucent space and union with the outdoors, while at the same time affording, in their radiant surfaces, secure comfort. The stepped pattern of these rooms is not the result of whimsey; they were successively projected from the facade in order to gain as much sunlight as possible, particularly in the colder seasons of the year. Room 1, as befits a place for sunbathing, shows upon investigation not only the greatest solar gain of all, but also the greatest constancy of sunlight throughout the day. Room 2, with it asymmetrical window, ranks second in this respect. Rooms 3 and 4 receive an almost equal proportion of sunlight, but less than Room 2. Room 5 receives the least of all, and most of this in its semicircular pool. This singularly inviting spot was very likely the most popular place in the Baths. Here the bather was offered the anomaly of outdoor bathing in a steam room; and the combination of cool air, sunlight and hot water, with a steamy refuge close at hand, must have given the ultimate touch of luxury.

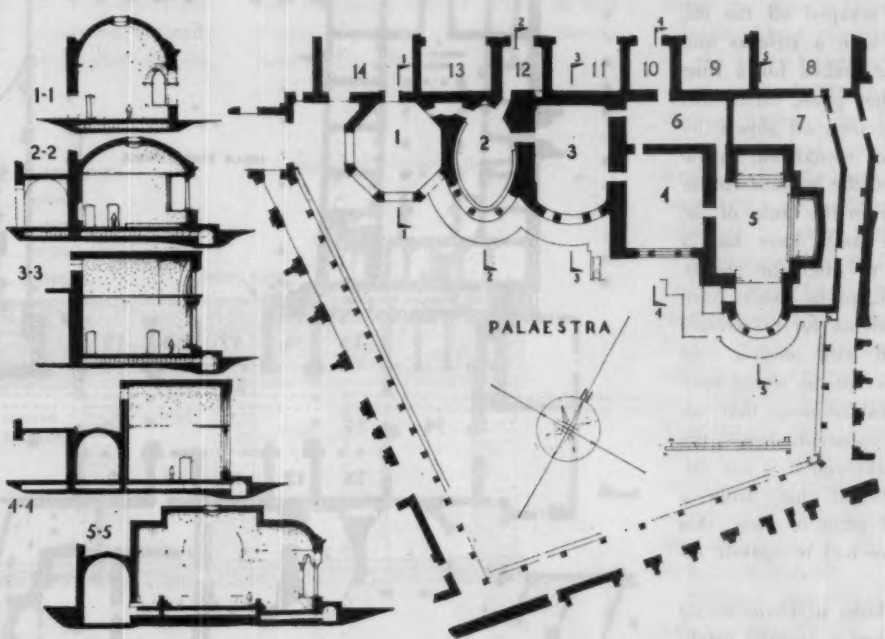

Fig. 3 — Plan and typical sections of the 5 Rooms in the southern portion of the Baths

Analysis of the Heating System

The functioning of the heating system that made these rooms possible is best revealed by an analysis based on that method of radiant heating design which deals chiefly with the regulation of the rate of heat loss from the human body, rather than with the rate of loss from the structure itself[2]. Since this method is primarily concerned with the conditions under which a human being may be comfortable, and only secondarily with the structure that provides these conditions, it is most appropriate for the analysis of an unfamiliar building-type. The analytic procedure consists of the following steps:

Step 1, establishment of probable heating surface temperatures; *Step* 2, derivation of air temperatures from these surface temperatures and from design conditions of wind and temperature; *Step* 3, determination of relative humidities from the derived air temperatures and from design conditions of humidity; *Step* 4, establishment of surface temperatures under various conditions of solar radiation; *Step* 5, calculation of the rate of heat loss of a *nude, normal adult* in the established environment.

If the rate of heat loss of this individual does not exceed his rate of heat generation, the established environment is considered satisfactory. Hence the comfort of the human being is the criterion of the structure's performance in providing a suitable environment. And if one may presume that men have changed very

little in the past 1600 years and that the same general requirements for comfort have therefore prevailed, this criterion is the safest to adopt for the analysis of an anomalous ancient structure.

Step 1: In order to proceed with *Step* 1 and determine the probable heating surface temperatures, it was decided to set the values of the thermal conductivities, k, of the various materials in the structure — such as marble, brick and tile — at the same values used for these materials today. For the dense concrete of the floor, containing limestone aggregate, a k of 11 Btu was assigned. For the wall and vault concrete, containing tufa aggregate, the k-value was taken as 7. The surface conductivity, f, of the interior building surfaces was set at 1.65, for still air; that for the exterior building surfaces was taken as 6.0 for a wind velocity of 15 mph.

The analysis then proceeded by assuming an average floor temperature of 100 F. The fires in the hypocausts would have formed a more obvious basis, but the scant information concerning them is quite inadequate. On the other hand, there is a surprising amount of evidence in Latin literature regarding the heat of the baths, the appraisal of which makes the assumption of 100 F a conservative one. This is further confirmed by the temperatures of modern Turkish baths, as well as by the fact that 100 F is not at all intolerable to bare feet.

With this floor temperature, and using the Equations A-1 to A-5 as stated in the Appendix† A, the temperatures of the wall and vault surfaces in each of the 5 rooms were calculated. They were found to be in the order of 102 to 110 F for the walls and 93 to 100 F for the vaults.

One of the operations (use of Equation A-1) in this part of the procedure of *Step* 1 indicated that the temperatures of the gaseous mixture of smoke, combustion gases and excess air under the floor was of the order of 125 to 300 F, while the corresponding temperatures in the tubes of the walls and vaults was of the order of 105 to 230 F.

Step 2: *Fixing the design air temperatures.* The first operation was to arrive at the design conditions of wind and outside air temperature, and this was done by studying the meteorological data for Rome at the present time. This is believed suitable for there is no evidence to show that the Roman climate of today is essentially changed from that of ancient times. As a result of this study (based on 1953) the following design conditions were arrived at: (1) a temperature of 30.2 F, with wind at 10 mph from the North; (2) a temperature of 37 F with wind at 7.1 mph from the Southwest.

The *inside air temperature* in each of the 5 rooms was then regarded as that temperature attained by an initial mixture of inside air and infiltrating air upon exposure to the warm surfaces of the room. The temperature was calculated by means of Equation B-1 of Appendix B, with its corollary Equations B-2, B-3 and B-4, and which permitted a simple calculation of the infiltration of outside air.

This method of calculating the infiltration is based on the belief that air movement within the rooms would have taken 2 principal directions: (1) in a more or less horizontal path between openings at the same general level; (2) in an ascending path from a low inlet to a high outlet.

Aside from the windows, the openings in the rooms consisted of doorways and of either high windows in the lunettes of the north walls or circular openings, called *oculi*, in the crowns of the vaults. The free area of these latter was regulated by means of a metal disc, rigged on chains directly beneath, so that it could be raised for complete closure or lowered for the maximum opening. The doorways were equipped with doors on pivot hinges and the high windows with hinged shutters.

With a southerly wind, there would have been air movement, due to wind pressure alone, from the windows to the doors at the north end of the room. There would also have been an exfiltration through the *oculus* or the high north window, due to a combination of wind pressure, the difference in temperature between outside and inside air, and the height from inlet to outlet. With a northerly wind, there would have been a generally upward air movement, from the doors at the north end to both the *oculus* and the upper part of the south windows. This movement would have been governed by a combination of wind pressure, temperature difference and height. Air coming through the high north windows under such conditions would have dropped until warmed by the air of the room, but its movement, governed principally by wind pressure, would still have been southerly.

Each of the rooms was examined under 5 conditions of infiltration, *viz*:

1. with a northerly wind — doors and oculus closed;
2. with a northerly wind — one door open and oculus closed;
3. with a southerly wind — doors and oculus closed;
4. with a southerly wind — one door open and oculus closed;
5. with a southerly wind — doors closed and oculus opened.

The velocity of air motion within the rooms was established only for its effect upon the *nude normal adult.* The additional heat gained from the room surfaces by moving air was disregarded. Air motion greater than 100 fpm was regarded as causing discomfort; that less than 50 fpm was regarded as ideal. The air speed within the room, V_m, was determined by the equation

$$V_{ot}/V_m = Q_m/Q_{ot} \quad \ldots\ldots\ldots\ldots\ldots (1)$$

where

V_{ot} = velocity of infiltrating air, feet per minute.
Q_{ot} = volume of infiltrating air, cubic feet per minute.
Q_m = volume of air in the room, cubic feet per minute = $Q_{ot} + Q_i$, in which Q_i = volume of inside air, cubic feet per minute.

Step 3: *Determination of Relative Humidities.* The relative humidity of

†It is planned to publish the Appendixes with this paper in the TRANSACTIONS.

the final, heated mixture of inside and infiltrated air — the air at the attained temperature (t, in the Equation B-1) — was established by the equation

$$\phi = p_w/p_s \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where

ϕ = relative humidity, percent.
p_w = partial pressure of water vapor, inches of mercury.
p_s = saturation pressure of water vapor, inches of mercury.

The design conditions for relative humidity were established from an average of the recorded relative humidities for January and February for Rome. A study of the meteorological data shows these months as the most humid of the 5 winter months; as might be expected, it also shows the highest relative humidities when southerly winds blow from the Mediterranean. A relative humidity of 63 percent was established as a design condition with north winds; 78 percent was established as a design condition with southwest winds.

Step 4: *Establishment of Surface Temperatures under Various Conditions of Solar Radiation.* The effect of solar radiation on the room surfaces was expressed as an increase in the radiant temperature of the room as a whole. This increase was obtained by regarding both the reflected and emitted solar radiation as additional heat emitted from the surface and by then computing the corresponding surface temperature for the increased emission. This temperature then represented the increased radiant temperature. The heat emission under these conditions — the black body radiation — was found by use of Equation C-1 of Appendix C.

Solar radiation, for horizontal and variously oriented vertical surfaces, was computed by use of Equation C-2 of Appendix C.

Values for direct solar radiation only were used in the computations because of the uncertainty of accurately calculating the effect of diffuse solar radiation upon the interior of a building. These values, moreover, were deduced for only cloudless (clear sky) conditions and for average conditions, a postulate that simplified the calculations without materially affecting the results.

Cloudy conditions were considered to allow of no direct solar radiation at all. Hourly values were considered necessary because of the evident limitation of use of the bathing rooms, for the references in ancient literature point to a customary bathing period from noon to 17:00, with its peak at about 14:30. Values were, therefore, deduced for the hours of 10:00, 12:00 and 14:30, under both clear sky and average conditions, and for December 21, March 21, June 21 and September 21. Shadows were cast upon a plan of the rooms at these 4 significant dates of the year and the areas of sunlight thus derived were used in the calculation of total radiation values. In the analysis, however, only the values for December 21 were used as a design condition because the unit radiation on this date is the lowest of the year. The total effective direct solar radiation, in respect to the room surfaces, was taken as the sum of reflected radiation and of previously absorbed radiation that was being emitted from surfaces of an absorptivity of 0.5 after a time lag of approximately 2 hours, a period that seemed consistent with the composition of the floors and walls and with their internal temperatures. Thus, for example, the total effective radiation at 12:00 was the sum of the reflected radiation at that hour and the absorbed radiation at 10:00. The effect of solar radiation was calculated for the interior of the rooms, only; no attempt was made to estimate the heat gain through walls and vaults by the action of the sun on the exterior of the building.

The results of the first 4 steps in the analysis thus served to fix the environmental conditions surrounding the bather, and consisted of surface temperatures, air temperatures, air speeds and relative humidities. They made it possible to proceed to *Step* 5.

Step 5: *Calculation of the Heat Loss Rate of a Nude Normal Adult in the Bath Environment.* The loss through radiation to the surroundings was calculated by the use of Equation D-1, while the losses through convection in both still and moving air at 50 percent relative humidity, were determined from Equations D-2 and D-3 of Appendix D.

The human loss through evaporation was approximated by a synthesis of experimental results gathered from nude, lightly clothed and normally clothed subjects in still air of 50 percent relative humidity. At humidities lower than 50 percent additional losses were approximated by the use of effective temperatures and a psychometric chart, as well as by Equation D-2 for convective loss in still air.

Table 1—Tabulation of the calculated performance of Room 3 with heated vault. A like table was prepared for each of the 5 Rooms

Conditions of Infiltration	Time of day	Conditions of Air: Temp F	Conditions of Air: Speed, fpm	Conditions of Air: Rel. Humid., %	Cloudy Sky: MRT, F	Cloudy Sky: Human Loss, Btu	Solar Radiation*: Average: MRT, F	Solar Radiation*: Average: Human Loss, Btu: 1	Solar Radiation*: Average: Human Loss, Btu: 2	Solar Radiation*: Clear Sky: MRT, F	Solar Radiation*: Clear Sky: Human Loss, Btu: 1	Solar Radiation*: Clear Sky: Human Loss, Btu: 2	Notes
1	10:00 12:00 14:30	82	18	9	88	**333**							
2	10:00 12:00 14:30	63	98	18	82	640	85 86 84		**316** **269** **343**				(*a*)
3	10:00 12:00 14:30	80	14	17	88	**333**							
4	10:00 12:00 14:30	53	124	43	80	800				86 89 85	**162** **60** **228**		(*b*)
5	10:00 12:00 14:30	65	48	28	83	585	86 87 85		**263** **216** **290**				

*The loss in Column 1 is for the bather standing out of the sun, and in Column 2 for the bather in the sun.

Note (*a*): Air motion near the maximum; sweating; possible discomfort. *Note* (*b*): High air motion plus probably heavy sweating; discomfort. Average of bold face figures is plotted in Fig. 4.

Human loss through conduction was disregarded on the assumption that the bather was standing at all times and was wearing bath shoes, or clogs.

The human subject chosen for the analysis — *nude normal adult* — was considered to be 5 ft - 8 in. tall, to weigh 155 lb and to have a body surface area of 19.5 sq ft. And although he was assumed to be standing, his metabolic rate of heat generation was taken as 400 Btu per hour, instead of the more usual 430 Btu. The lower rate was chosen as a factor of safety.

Presentation of Results

Results of the analysis of the system were worked up into tables — one for each of the 5 rooms — and one of which is included here as Table 1. In it, the reactions of the room under the calculated design conditions are in terms of human heat loss, but in a manner that emphasizes what might loosely be called heat *gains, i.e.,* losses below the metabolic rate of 400 Btu per hour. These losses below the metabolic rate, however, do not here signify excessive storage of heat in the body. For in cases of apparently small loss, this loss would have been increased by heavy sweating, a condition not wholly reflected in the method of calculating evaporative losses. And in actual practice, additional ventilation or the banking of the fires would have been employed to raise the total human loss to a supportable rate. The computed values of human loss result from the nature of the examination, which was based for all rooms on one set of premises and one set of design conditions. These values were therefore chosen as a means of expressing the reactions of the rooms, not because they represent an altogether accurate physiological picture of the plight of the *nude normal adult,* but because they offer a common, human denominator for describing and comparing rooms that have all been examined under the same criteria. Fig. 4 is a synthesis of the results from the tabulation for each room.

Comments and Some Implications of the Study

Although the discovery of many technical details of hypocaust operation must wait upon further research, the analysis here described did disclose enough of the system's functioning to demonstrate its ability to achieve a condition of comfort in spaces of large volume open to the outer air, and confirmed the success of the solution of a problem that would be considered unique even by modern standards. The success of the solution rested largely upon the heating system, but it also required the support given by skillful planning in the manipulation of the local climate.

The buildings along the southeast and southwest sides of the palaestra were of only 2 stories — high enough to act as windbreaks but low enough to admit the winter sun. The building on the northeast was at least 3 stories high and gave the most protection against the worst weather. The principal entrance to the palaestra — from the Forum — was in the westerly corner. This broad opening allowed the afternoon sun to reach Room 1, but it also provided

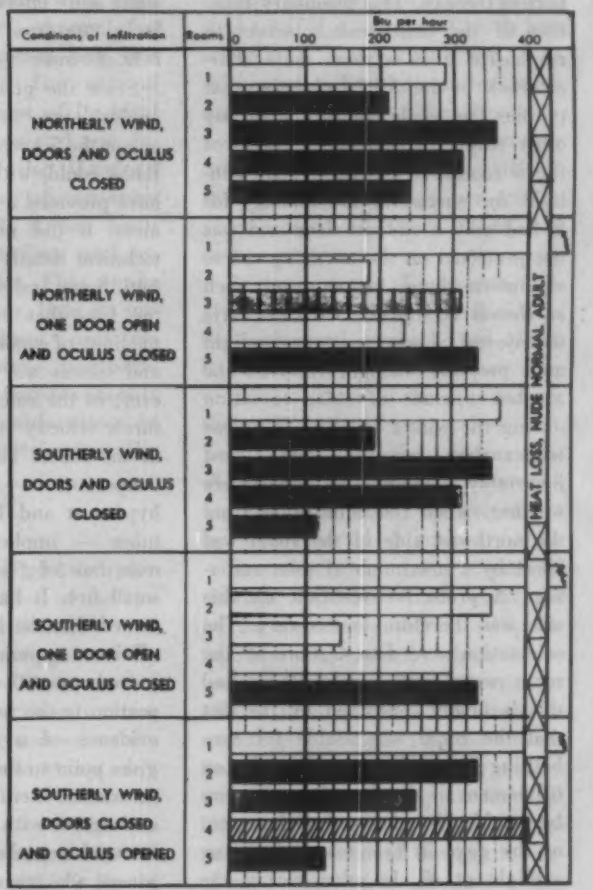
Conditions of Infiltration
Rooms
Btu per hour
0
100
200
300
400
NORTHERLY WIND, DOORS AND OCULUS CLOSED
NORTHERLY WIND, ONE DOOR OPEN AND OCULUS CLOSED
SOUTHERLY WIND, DOORS AND OCULUS CLOSED
SOUTHERLY WIND, ONE DOOR OPEN AND OCULUS CLOSED
SOUTHERLY WIND, DOORS CLOSED AND OCULUS OPENED
1
2
3
4
5
HEAT LOSS, NUDE NORMAL ADULT
(BLACK BARS INDICATE CLOUDY CONDITIONS; UNSHADED BARS ARE FOR CLEAR SKY CONDITIONS WITH BATHER IN THE SUN; THE 2 SHADED BARS INDICATE AVERAGE CONDITIONS WITH BATHER IN THE SUN; THE CROSS-HATCHED BAR SHOWS A CLEAR SKY CONDITION WITH BATHER OUT OF THE SUN.)

Fig. 4 — Heating performance of Rooms under various extreme and average conditions in terms of human heat loss

the only real ingress for occasionally bad southwesterly weather. Since such weather, in winter, is rare for the locality and generally cloudy, it would not have permitted sunbathing, and would therefore not have found the heliocaminus in use; at such times this room would have acted as a windbreak for its neighbors to the east. This secondary function of the heliocaminus serves to emphasize it as a room more characteristic of the skillful planning that typifies the whole complex than any other single space therein. Alone of the 5 rooms, it depended upon sunlight for successful functioning, for it had only a radiant floor and was not protected on the north by spaces of intermediate temperature, such as Rooms 10 and 12. On clear days it enjoyed almost constant sunlight and, properly enough, received the greatest amount of solar radiation during the winter months. The clear winter days, however, were almost invariably those of northerly weather, when the infiltration from the northwest side of the room was offset by a maximum of solar radiation. A protective vestibule on this side was therefore unnecessary. The orientation and fenestration of the room were very nearly ideal, and this is finally confirmed by the fact that the room was usable for sunbathing by *nude normal adults* on 67 percent of the days from November to March, when only 68 percent of the days in this season had any sunlight at all. In other words, the room was usable 98 percent of the time.

Whereas the other 4 rooms along the southern facade were designed to utilize solar radiation, they all could function without it. Their planning, however, did not neglect the need for protection against the north. Rooms 10 and 12, with radiant floors and side walls that received surplus heat from the hypocausts of Rooms 6 and 3, respectively, acted as vestibules to Rooms 6 and 2. And Room 6, in turn, was an additional buffer for Rooms 4 and 5. The semi-circular vestibule between Rooms 1 and 2 contained a radiant floor and north wall and effectively screened the laconicum from the cool air of the heliocaminus.

Since the primary purpose of the analysis was to determine whether or not the 5 open rooms of the Forum Baths could, with unglazed windows, have provided a comfortable environment, it did not reveal all of the technical details of hypocaust operation. Some insight into the nature of the fires that produced the heating medium of smoke, combustion gases and excess air was obtained, however, in the calculations of this mixture's velocity in the hypocaust and in the tubes. The relatively low gas temperatures — 125 to 300 F in the hypocaust and 105 to 230 F in the tubes — implies not only a small mass flow of gas but also a relatively small fire. It has generally been assumed that the hypocaust was an inefficient apparatus in that it required quantities of fuel out of proportion to the heat it produced. This evidence of a small fire, however, gives point to the several implications in ancient literature of a *gentle fire*, and agrees with the findings of Fritz Kretzschmer, the German heating engineer who operated a reconstructed hypocaust in the Saalburg[4]. The chances are, therefore, that the hypocaust was a comparatively economical apparatus, which should be no great surprise to those who have computed fuel costs for properly designed modern radiant heating systems.

The implications of this study and analysis for modern heating practice need not be historical only. That the Forum Baths provide an ancient example of the advantages of proper orientation and of a respect for the conditions of the climate does not make that example less pertinent to modern practice, where these advantages are in danger of neglect through a mistaken reliance on gadgetry. Nor does the age of these ruins lessen the strength of their demonstration that there is more perception, logic and efficiency in using natural forces than in unnecessarily resisting them. Most important of all, the Forum Baths, in an almost dramatic fashion, testify to the efficacy of radiant heating, particularly in spaces of large volume. And they emphasize the signal quality of this heating method, which is its direct application to the essential problem of making people comfortable. Faced with the complex requirements of modern architecture, and often with a lack of cooperation from architects themselves, it is understandable that heating design should be almost forced into time-saving techniques that emphasize building heat loss at the expense of more pertinent human factors. But with current technological advantages, modern practice should be able to do better — to do at least as well as the Romans who, by accident or not, made man the measure of their purposes.

References

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2. HEATING VENTILATING AIR CONDITIONING GUIDE 1937, pp. 705-714; and also see 1953 edition, pp. 551-572 (published by the AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS, New York, N. Y.).

3. Hypokausten, by Fritz Kretzschmer (*Saalburg Jahrbuch*, Vol. 12, 1953, pp. 7-41).

Acknowledgments

The author acknowledges the courtesy of the American Academy in Rome in granting its permission to make use of the illustrations here presented.

Atomic Recovery for Space-Heating at Hanford

By S. L. Nelson*, Richland, Wash.

SUMMARY—The Hanford system for the recovery and utilization of atomic energy for space-heating purposes has now been in operation for several years. It was the first of its kind in the United States and was installed on one of the Hanford reactors at the time of construction. As predicted, it has been remarkably trouble-free and inexpensive to operate. This paper describes the system, lists its important specifications, and reviews its operational performance. Suggested improvements are noted for consideration in designing similar future installations.

THE performance of the Hanford system for the recovery and use of atomic heat is of considerable interest, particularly because it was the first installation of its kind in the United States and one of the first in the world. During the several years it has been in service, it has continued to furnish inexpensive, dependable heat to all of the offices, shops, and buildings associated with the reactor. It is particularly attractive in this connection since large amounts of heated air are required in the ventilation of the reactor building (168,000 cfm warmed to a temperature of 72 F). Also to be considered is the fact that in this reactor, a single-purpose plutonium producer, heat is a by-product, disposed of by returning the heated effluent water to the Columbia River.

This fact of ready availability of large quantities of waste heat does not, however, in any way detract from the significance of the successful performance of the system. The feasibility and ease of application of the system's general principles to the heating requirements of every heat-producing reactor have been well established.

Description, Specifications, and Operating Experience

Basically, the Hanford heat recovery system is a counter-pass shell and tube heat exchanger which transfers heat from the reactor cooling water to a 34 percent ethylene-glycol and water solution which is circulated to radiators and other space-heating elements located within the reactor building and in nearby shops, offices, and other buildings. Fig. 1 is a diagrammatic representation of the system. Since its installation several years ago, it has been operated by the General Electric Co. as part of the Hanford Project with only minor routine maintenance and essentially no direct operating cost except electricity to drive the circulating pumps.

The main heat exchanger was designed to recover 50,000,000 Btu of useful heat energy per hour from atomically heated water used to cool the reactor. Specifications called for heat transfer to 5,850 gpm of 34 percent ethylene-glycol solution entering the exchanger at 120 F from 10,000 gpm of process water entering the exchanger at 150 F and leaving at 140 F.

The central heat exchanger (Fig. 2) consists of two tube and shell sections, side-by-side, connected in series. The heated process water and the ethylene-glycol solution move in opposite directions in counter-pass circulation. The shell is of stainless steel (*ASTM* A-285 Gr.C), 23 ft long and 3 ft in diameter with five ½ in. thick steel baffle plates inside to assure proper mixing of the glycol solution. The tubes are of admiralty brass (*ASTM* B-11), ¾ in. OD, 16 ft long with 1150 tubes per section. They provide a total of 7200 sq ft of exchange surface.

Pressure drop of the ethylene-glycol solution (in the shell side of the exchanger) was specified at not more than 10 psig and pressure drop of process water in the tube side of the exchanger at 8 psig or less.

In operation, the system has shown itself to be capable of exceeding the heat recovery requirements by a considerable margin.

Heated process water is pumped through the tubes of the exchanger by an electrically driven, self-priming centrifugal pump which draws some 10,000 gpm from the reactor effluent stream, pumps it through the exchanger and back into the effluent line. Experience has shown that a flow of water fully adequate for heating requirements can be, in this installation, maintained through the exchanger simply by siphoning action (without the pump) once the flow is started. The pump is designed to operate for 6 months without attention, but since it is used only a small part of the time, it requires almost no attention. Temperature of the process water varies with operating conditions and river water temperature but is in the general range of 165 F when it enters the exchanger. The process water pump, the main heat exchanger and connecting lines are installed in an outside, fenced-in enclosure and are uninsulated.

*Processing Manager, General Electric Co.

The pumps for circulating the ethylene-glycol solution are installed inside an existing building. All piping for the circulation of ethylene-glycol is either buried in the ground (without insulation) to a depth of about 4 ft or run along existing tunnels carrying other lines. Due to its large volume (approximately 30,000 gal), the glycol system will retain usable heat for about an hour with the heat source shut off. This allows for steady operation and easy transfer to the steam back-up system if necessary.

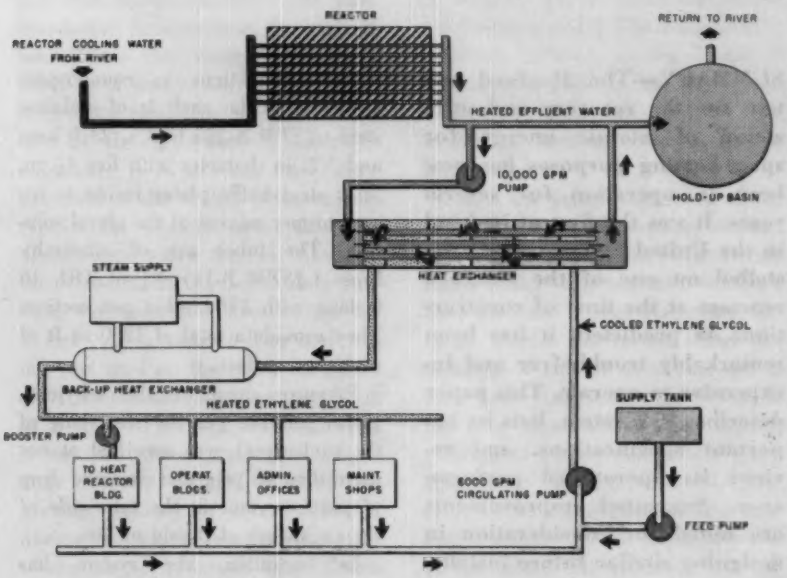


Fig. 1 — Schematic diagram of heat recovery system

If the reactor is shut down unexpectedly, the flow of water through the heat exchanger should be stopped; otherwise, the heat exchanger works extremely well in reverse and cools the circulating glycol quite rapidly.

At present this shut-off is attended to by a motor valve operated by a push-button switch at the central control panel. In the design of a similar future system it would be well to provide for shut-off to take place automatically. If this valving is not attended to rather quickly, considerable heat is lost into the cooling water, requiring unnecessary use of back-up steam heat. Modification of the existing installation to provide for automatic valve control is being currently considered.

Two 5000 gpm electric, centrifugal pumps and one small (600 gpm) pump are provided for circulation of the glycol solution. They may be used singly or in combination, allowing some flexibility in the rate of circulation which may be varied according to heat load demand. Here also some improvement could be made in future designs.

Variations in process water temperature result in similar variation in glycol temperature unless some control is applied. This, as explained, is now done by varying pumping rates and also by manually adjusting a by-pass line which allows recirculation of a portion of the glycol without a pass through the heat exchanger. An automatic by-pass control valve to maintain a more even glycol solution temperature would be a desirable improvement. Control of heat output in the individual radiator units is automatic but these controls would give smoother operation if they did not have to respond to two variables: room temperature and changes in the temperature of the heating fluid. These changes do not occur frequently and actually do not present a significant problem, but such a modification would improve the system.

The steam back-up feature mentioned earlier is self-regulating and available at all times, coming on automatically if it is required. It consists of a steam-to-water heat exchanger on a bypass line installed near the circulating pumps and fed from standby boilers already built into the overall back-up system to provide steam for the generation of emergency electrical power.

All pump motors are controlled from a central operating panel; however, normal operation is automatic and the only attention required is inspection of the equipment. Hand-operated valves are available for sectionalizing and isolating portions of the system, but this has not been necessary since only minor glycol leaks have occurred. No facilities were built into the system for pumping out the glycol from the isolated section of pipe and storing it for reuse. Consequently, the draining and storing of the glycol, if necessary, would have to be done by portable equipment since the solution is too valuable to simply dump. It would probably be desirable in similar future installations to include a large tank with appropriately located drain lines for draining and storing the glycol from portions of the line during system maintenance. Capital cost considerations would weigh heavily in any decision as to the type of storage facilities provided.

Pressure on the glycol is maintained at 35 to 75 psi. Additions of ethylene-glycol solution are made automatically and usage from the make-up tank is measured. In this way the entire system may be easily

monitored for leaks. A 10,000-gal underground tank is provided for storage of the pure ethylene-glycol and a similar tank for make-up and expansion of the fluid.

Radiation Aspects

A positive pressure is maintained on the glycol solution to prevent possible entry of process water into the glycol in the event of a tube failure in the main heat exchanger. Pressure differential is not critical so long as some positive pressure is maintained. No trouble of this sort has ever occurred and it is not regarded as a problem.

The primary heat exchanger is unshielded although a fence is provided to prevent the approach of personnel any closer than 50 ft except under regulated conditions. The radioactivity of the process water, while at a rather high level as it leaves the reactor, dies off rapidly after entering the effluent line. Most of the radioactivity in the water is due to minute amounts of Mn 56, Na 24, and other short half-life radioactivity from trace minerals found in the waters of the Columbia River. If maintenance work on the main heat exchanger should ever be necessary, it may be performed simply by draining the exchanger and taking normal low-level contamination precautions. At the time of installation it was pointed out that ethylene-glycol could break down into formaldehyde under irradiation; however, no breakdown of the glycol solution has occurred. Gamma radiation levels in the exchanger are relatively low.

Practically speaking, the system, overall, has presented fewer operating and maintenance problems than have conventional heating systems used in the other Hanford reactors. Complete elimination of *freeze-ups*, absence of steam leaks, condensate problems, and insulation difficulties account for the improvement.

There has been no trouble whatever due to mixing of the process water and the ethylene-glycol solution or in the performance of the main exchanger. Generalizing, the fact that this system draws its heat from water heated directly by atomic energy has not complicated the problems of operation and maintenance to any extent.

In the design of future reactors, the inclusion of systems to provide for space-heating requirements through utilization of atomic heat could probably be made easily. Consideration would need to be given to the practicability of each case on an individual basis, but experience with the Hanford system has been sufficiently favorable to make the picture look very good indeed. In fact, a study is being made of the feasibility of expanding the system to heat boiler feed water for the emergency steam generating plant.

Summary and Conclusions

In summarizing, the Hanford atomic heat recovery system has performed successfully during its several years of use. It has fulfilled performance requirements and has been economical to operate.

Based on experience with this system, new reactor designers should favorably consider including provisions for obtaining space heat, hot water, boiler feed water heat and, in fact, all normal heat requirements of supporting facilities from the heat of the reactor itself by means of simple heat exchangers.

Specifically, such systems should include: (1) provisions for emergency back-up to fill heating requirements while the reactor is shut down; (2) flexibility to permit easy adjustment to changes in reactor operating temperature, including adequate provisions for expansion and contraction of lines and exchangers over wide temperature ranges; (3) some provision (such as pressures differential) to guard against accidental mixing of the cooling liquid or gas from the reactor with the fluid circulating to the space heaters.

Fig. 2 — Central heat exchanger

Acknowledgments

The author acknowledges the assistance given by colleagues at General Electric Co. and by the C. T. Main Co., which companies are the designers of the system.

After the Semi-Annual Meeting . . . .

Vacation in Minneapolis

By now every Society member knows that the ASHAE Semi-Annual Meeting 1958 will be held June 23-25 in the Pick-Nicollet Hotel and the *ASRE* 54th Annual Meeting will take place at the same time in the Leamington Hotel.

You and your family can count on a wonderful and pleasant time in Minneapolis. Plan a Minnesota vacation after the Semi-Annual Meeting and relax in the *Land of the Lakes*. There are many lake-side resorts and family accommodations, and right within Minneapolis there are 22 lakes ideal for bathing, boating and fishing.

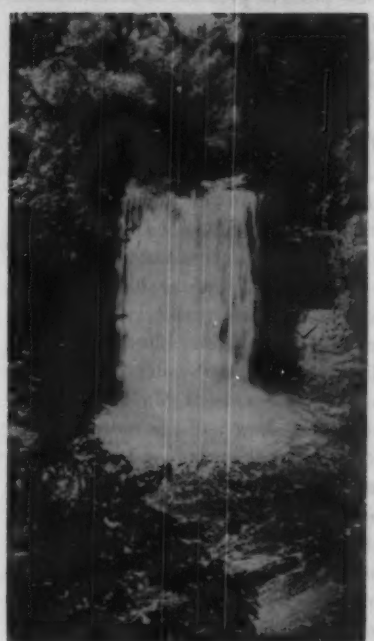
Although meetings are scheduled for Saturday and Sunday, June 21 and 22, the Semi-Annual Meeting will officially open on Monday morning, June 23. There will be five Sessions, including nine papers and two Symposiums. *ASRE* plans to hold three Technical Sessions with nine papers on various subjects. In addition *ASRE* will have a Domestic Refrigeration Engineering Conference on Monday morning, and six Forums on Tuesday afternoon.

The two Societies are planning several Joint Sessions, as well as a number of special events. A County Fair on Monday evening and a Joint Dinner followed by dancing on Tuesday evening are two of these events. Tuesday morning there will be an ASHAE-*ASRE* Joint Symposium on Insulation, and on Tuesday afternoon there will be an *ASRE*-ASHAE Joint Conference on Air Conditioning. Wednesday morning there will be an ASHAE-*ASRE* Joint Symposium on Condensing Methods, and in the afternoon an *ASRE*-ASHAE Joint Conference on Education.

The Minneapolis Chapter Committee on Arrangements and the *ASRE* Twin Cities Section Committee on Arrangements have been working together in the planning of many interesting special events, as well as programs for the ladies and children. Monday afternoon ASHAE will have a golf tournament at the Golden Valley Country Club with *ASRE* members and guests invited. Tuesday afternoon *ASRE* will have a golf tournament at the Edina Country Club with ASHAE members and guests invited.

Participation in the ASHAE Semi-Annual Meeting and the *ASRE* 54th Annual Meeting, as well as an opportunity to vacation in Minnesota, will be pleasant and enjoyable for all the family.

Come to Minneapolis in June!



PROGRAM — SEMI-ANNUAL MEETING

Pick-Nicollet Hotel **June 23-25, 1958** **Minneapolis, Minn.**

(All meetings and events at Pick-Nicollet Hotel unless indicated otherwise)

Saturday — June 21

9:00 a.m. Finance Committee
J. N. Livermore, *Chairman*

10:30 a.m. Executive Committee
A. J. Hess, *Chairman*

1:30 p.m. Regions Central Committee
Walter A. Grant, *Chairman*

2:00 p.m. Research Executive Committee
E. F. Snyder, Jr., *Chairman*

4:30 p.m. Program and Papers Committee
John Everetts, Jr., *Chairman*

Sunday — June 22

9:00 a.m. Council Meeting

10:00 a.m. REGISTRATION (*East Room*)

2:00 p.m. Committee on Research, E. F. Snyder, Jr., *Chairman*

3:30 p.m. Reception — Hospitality Time (*Junior Ballroom*)

7:30 p.m. Conference of Chapter Editors and Publicity Chairmen, E. K. Wagner, *Chairman*

9:00 p.m. Reception — Aquatennial Preview (*ASRE* Leamington) (ASHAE Members and guests invited)

Monday — June 23

8:30 a.m. REGISTRATION (*East Room*)

9:00 a.m. FIRST SESSION (*International Ballroom*)
Call to Order — Pres. E. R. Queer
A Water - Cooled Luminaire in a Panel - Air System, by W. F. Spiegel
Pulsations in Residential Gas Furnaces with Multiple-Port Burners, by A. A. Putnam
Evaluation of Air Cleaners for Air Conditioning and Ventilation, Part I — Apparatus, by K. T. Whitby, A. B. Algren, R. C. Jordan, and J. C. Amis

9:30 a.m. Ladies' "Get Acquainted Brunch" (*Junior Ballroom*)

9:30 a.m. Children's Tour to Como Park Zoo, State Capital and University of Minnesota Campus. Includes lunch

11:00 a.m. Ladies' Trip to Southdale — nation's largest shopping center under one roof

12:00 noon Welcome Luncheon (*Lakeland*)
Toastmaster: John E. Haines, Past Pres. ASHAE
Speaker: Hon. P. Kenneth Peterson, Mayor of Minneapolis

12:00 noon ASHAE Golf Tournament at Golden Valley Country Club (*ASRE* members and guests invited)

5:00 p.m. ASHAE "County Fair" (*ASRE* Members and guests invited)

Tuesday — June 24

8:30 a.m. REGISTRATION (*East Room*)

9:00 a.m. SECOND SESSION (*Lakeland*)
Call to Order — 1st Vice Pres. A. J. Hess
Winter Infiltration Through Swinging-Door Entrances in Multi-Story Buildings, by T. C. Min
Corrosion Inhibition on Tubes in Low-Pressure Steel Boilers, by W. A. Keilbaugh and F. J. Pocock
Heat Gain Through Windows Shaded by Canvas Awnings, by Necati Ozisik and L. F. Schutrum

9:30 a.m. THIRD SESSION (*International Ballroom*)
Call to Order — 2nd Vice Pres. Walter A. Grant
SYMPOSIUM ON THERMAL INSULATION — Joint with *ASRE*
P. N. Vinther, *Symposium Manager*
M. W. Keyes, *Moderator*
How Research Can Improve Performance of Fibrous and Reflective Insulation, by William Turbeville
Block and Pipe Insulation, by R. B. Crepps
Vapor Problems in Thermal Insulation, by N. B. Hutcheon
Thermal Insulation for Nuclear Systems, by C. G. Collins and G. W. Pomeroy
Surfacings for Glass Fiber and Foam Thermal Insulation, by W. P. Ellis

10:00 a.m. Bus Trip and Children's Swimming Party

10:30 a.m. Joint ASHAE-*ASRE* visit for The Ladies to Betty Crocker Kitchens and new General Mills Headquarters Building; luncheon at Wayzata Country Club

1:00 p.m. *ASRE* Golf Tournament, Edina Country Club (ASHAE members and guests invited)

1:30 p.m. Nominating Committee (*Aquatennial, 3rd Floor*)

2:30 p.m. *ASRE* Conference on Air Conditioning — (*Leamington Hotel*). Joint with ASHAE

6:30 p.m. Cocktail Party — *ARI* Host (*Leamington Hotel*)

7:30 p.m. Joint Dinner (*Leamington Hotel*)
Presentations — Followed by dancing

Wednesday — June 25

8:30 a.m. REGISTRATION (*East Room*)

9:00 a.m. FOURTH SESSION (*International Ballroom*)
Call to Order — Treas. J. H. Fox
SYMPOSIUM ON CONDENSING METHODS — Joint with *ASRE*
W. G. Hole, *Symposium Manager*
A. J. Hess, *Moderator*
Cooling Tower Design and Performance, by John Engalitcheff
Evaporative Condensers, by D. D. Wile
Air Cooled Condensers, by Otto Nussbaum
Economic Evaluation of Condensing Methods, by J. L. Wolf

9:00 a.m. FIFTH SESSION (*Lakeland*)
Call to Order — Pres. E. R. Queer
Activated Charcoal for Air Purification, by H. L. Barnebey
Cooling Load from Pretabulated Impedances, by Harry Buchberg
Solar Energy Utilization for Heating, Cooling, Distillation and Drying — prepared by members TAC on Solar Energy Utilization
Report of Resolutions Committee
Unfinished Business; New Business; Adjournment

1:00 p.m. Ladies' Card Party (*Candlelight Room*)

1:30 p.m. *ASRE* Conference on Education (*Leamington Hotel*) Joint with ASHAE

1:30 p.m. Children — Supervised visit to CINERAMA

MEN'S INSPECTION TOURS

Monday — June 23 — 1:30 p.m.

Tours of Minneapolis-Honeywell facilities: (1) Downtown Plant — manufacturing; (2) Research Center; (3) Executive Offices. These will each last one to two hours.

Tuesday — June 24 — 1:30 p.m.

Southdale Shopping Center, the nation's largest shopping center under one roof, where you will visit an interesting and unique Mechanical Plant including the latest type of plant automation equipment.

Sign up at the ASHAE Registration Desk upon arrival.

JOURNAL SECTION

ARI STANDARD ON ROOM AIR CONDITIONERS

A new edition of the *ARI* Standard on room-conditioners has been published. It is designated as Standard 110-58 and supersedes the earlier Standard 110-56.

The revised standard changes the temperature conditions to be used in testing some of the room units. Conditions have been rewritten in the new standard covering maximum operating conditions, low-temperature operation, insulation efficiency, and condensation removal. None of these establish capacity ratings for room units, but rather, they serve to establish minimum performance requirements.

The new edition also contains other revisions including a clarification of manufacturing tolerance on published ratings of units. It specifies the use of revised Underwriters' Laboratory Standard 484 in specifying nameplate electrical data and safety tests. The revised standard is available from *Air Conditioning and Refrigeration Institute* at a price of 35 cents per copy.

NUCLEAR CONGRESS ATTRACTS LARGE ATTENDANCE

This year's Annual Nuclear Congress was a week-long affair. Opening on March 16, the Congress attracted nearly 3000 registrations for the technical conferences, exclusive of attendance recorded at the International Atomic Exposition.

Of chief interest to ASHAE members, perhaps, was the attention directed in the Congress toward heat for industrial processes. The applications contemplated are for temperature in the neighborhood of 600 F and therefore cover the range suitable for conventional district-steam and hot-water space-heating systems. Ventilation for the containment shells enclosing nuclear reactors, and air-conditioning for *hot laboratories*, represent unusual and important professional contributions by ASHAE members in the fields of nuclear technology.

The conference itself was organized as an activity of *Engineers Joint Council*. It became the nation's largest gathering of engineering and scientific personnel concerned with the development and application of peaceful uses of energy derived from the atomic nucleus.

Some 30 engineering societies, including ASHAE, cooperated in sponsoring the 4th Nuclear Engineering and Science Congress, arranged under leadership of the *American Nuclear Society*. Meetings were all held at the International Amphitheater concurrently with the Exposition. The 37 sessions, exclusive of luncheon and dinner events, had about 190 papers predominantly relating to: nuclear reactors for power generation and research, including production and processing of their fuel elements; application of radioisotopes; treatment and disposal of radioactive wastes; the provision of safeguards against hazards from radioactivity; nuclear education and standardization.

Representing the Society at the Nuclear Congress was W. F. Friend, chairman of the ASHAE Nuclear Energy Committee. Mr. Friend is a Director of *American Nuclear Society* and of other professional engineering societies and industry associations active in nuclear fields. He is now participating in advance arrangements for the next Nuclear Congress, planned for Cleveland in April 1959.

Another part of the Congress was the 6th Atomic Energy Conference staged by Atomic Industrial Forum, Inc., jointly with the National Industrial Conference Board. The three-day program conducted at Palmer House had a registration of about 825 for the 18 sessions. Subject matter covered was designed to provide management with a comprehensive review of technical and economic progress made throughout the world, toward the development of commercial nuclear power and of other industrial uses for atomic energy. Financial, legal and administrative problems, as well as international activities, were included on the program.

The 6th Hot Laboratories and Equipment Conference under the direction of an independent semi-formal Committee, was concerned with facilities and techniques of research and production laboratories specializing in radioisotopes. Its meetings, spread over three days, likewise were conducted at the International Amphitheater.

The 4th International Atomic Exposition, sponsored by the *American Institute of Chemical Engineers* with cooperation from four other of the constituent engineering societies composing the *Engineers Joint Council*, had several hundred exhibitors' booths. Nuclear instrumentation and metallurgy were quite prominent, in number and variety, as well as displays of reactor types for electric power generation and for research, along with component parts displayed separately from manufacturers.

Nearly all the papers of the Nuclear Engineering and Science Congress, except panel discussions, were preprinted and copies can be purchased at *AIChE* headquarters. *Proceedings of Atomic Energy in Industry* are expected to be published in July and will be obtainable from either of the two sponsoring organizations. *Hot Laboratory Proceedings* can be purchased from *AIChE*.

NOTICE OF SEMI-ANNUAL MEETING 1958

Please take notice that the Semi-Annual Meeting 1958 of the AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS will take place in the Pick-Nicollet Hotel, Minneapolis, Minn., beginning at 9:00 a.m. on Monday, June 23, 1958. The attention of the membership is called to the program of the meeting appearing on page 165.

There will be 5 technical sessions including a Symposium on Thermal Insulation (Joint with *ASRE*) and one on Condensing Methods (Joint with *ASRE*). Nine papers will be presented at the sessions.

If you have not already made reservations for hotel accommodations and transportation to Minneapolis, this should be given immediate attention.

E. R. QUEER
President

A. V. HUTCHINSON
Executive Secretary

May 14, 1958

TAC ON INSULATION MEETS

The Technical Advisory Committee on Insulation held a meeting at the Laboratory at Cleveland on March 25-26. At the meeting, the committee voted on 6 recommendations having to do with revisions and changes in various places in THE GUIDE. The committee also completed its organization with the formation of 10 Task Groups, each charged with specific responsibilities in carrying out the general work of the committee.

SAFETY STANDARD ON WELDING AND CUTTING

A revision of the *ASA* Standard on Safety in Welding and Cutting is available bearing the code number *AWS-ASA Z49*. The present publication is an American Standard. Fire and eye protection are both included. So also is health protection and ventilation which are based on 3 factors: dimensions of working space; number of welders; and evolution of hazardous con-

taminants. Recommendations are included as to precautions necessary to give adequate ventilation and health protection to personnel. Copies of the Standard may be obtained from *American Welding Society* at $2.00 per copy.

HONORED BY LIFE MEMBERSHIP

by recent action of Society's Council

Frank R. Kelble: Philadelphia, Pa. « « « Former Chairman and Vice President-Manager of The Huffman-Wolfe Co. of Philadelphia, and now retired. « « « Born in Xenia, Ohio, was employed or engaged in heating and ventilating since 1908. Built many commercial and industrial heating and ventilating plants. « « « Member of ASHAE since 1928. Other societies are the *ASRE, ASSE,* the Knights of Columbus, Franklin Institute and the Navy League.

Philip Rosenberg

W. Clifton Randall

W. Clifton Randall: Birmingham, Mich. « « « Formerly Chief Engineer and Director of Research of the Detroit Steel Products Co., now retired. « « « Born in Bothwell, Ont., B.Arch. from the University of Michigan. Became a member of ASHAE in 1928, served on several committees of the national Society and chairman of some Michigan Chapter committees. Published numerous articles on ventilation, lighting, and aeration, several of them in this JOURNAL. Belonged also to the *ASTM* and the Illuminating Engineering Society.

Philip Rosenberg: New York, N.Y. « « « Owned Somaran Sheet Metal Corp. from 1922 to 1933. Associated with Universal Steel Equipment Corp. from 1933 to 1957. « « « Specialized in air-conditioning of schools and other large buildings. « « « Holds 21 U.S. patents for steel and store equipment invented during and after World War II. « « « Born in Latvia; now retired to Florida. He is a Mason and has been in the New York Chapter of ASHAE since 1928.

Rutcher Skagerberg: Washington, D.C. « « « Employed by the Public Housing Administration as a Special Engineering Officer engaged in special studies and research until June Retirement. « « « Was born in La Crosse, Wis., and attended the U. of Minnesota and M.I.T. « « « Was engineer for Minneapolis-Honeywell Regulator Co. for 17 years and later a mechanical engineer for the U.S. government. « « « Has published many

Rutcher Skagerberg

Method of Choosing Location of, Financin g and Conducting Meetings of the Society

Resolved: That inasmuch as the Annual and Semi-Annual Meetings of the Society come under the jurisdiction of the Council, the following rules governing the handling of such meetings be adopted by the Council and published in the JOURNAL of the Society at least twice during every year, preferably just prior to each meeting.

1—The Council will select the city in which the Annual or Semi-Annual Meeting is to be held, giving due consideration to the invitations received from Chapters or members as well as to the advisability of so distributing those meetings as to make them of the greatest advantage to the general membership, and to reduce as far as possible the expense of members attending.

2—That an appropriation be made to cover the entertainment or local expenses, incurred in connection with the meeting, and the regular meeting expenses to be taken care of by the General Fund of the Society in the regular way.

3—That no registration fee or compulsory obligations of any nature be imposed on members or guests.

4—That the purchase of tickets for banquets or for any other form of entertainment that may be provided be entirely voluntary.

5—That the grouping of features and the sale of tickets for group features be discouraged.

6—That the raising of funds from manufacturers or heating apparatus be discouraged.

7—That the display of samples, or of literature, advertising the product of any manufacturer in any way, shape or form, be not permitted at the booths, registration desk, or in or about the meetings.

8—That the distribution of trade papers be entirely at the discretion of the committee in charge.

9—That the local Chapter or local members be empowered to form a General Committee with such sub-committees as may be required to handle the details of transportation, hotel accommodations, entertainment, finance, etc., that this General Committee be requested to confer frequently with the Council, through the Executive Secretary of the Society, and to make frequent reports on progress in connection with the various matters being handled by them.

10—That the arrangements of elaborate and costly entertainment features be discouraged.

Adopted at Council Meeting, January 29, 1926.

JOURNAL SECTION

technical papers, one in the JOURNAL. Joined the Society in 1921 and also belongs to *ASTM*, the Building Research Institute, the American Society for Advancement of Learning and other groups.

SOCIETY MEMBERS ARE *ARI* OFFICIALS

The new treasurer of *Air-Conditioning and Refrigeration Institute* is Past Pres. L. N. Hunter, Johnstown, Pa. Other Society members are also on the Board of Directors. They are John Engalitcheff, Jr., Baltimore, Md.; Russell Gray, Syracuse, N. Y.; B. E. James, Minneapolis, Minn.; and V. D. Wissmiller, Minneapolis, Minn.

SOCIETY CONTROL CONFERENCE RECOMMENDS ACTION

The Society should take action at the professional level concerning control devices, their application, and their performance. Research is needed as are educational facilities and the publication of available information.

These several recommendations and conclusions were adopted by the Control Conference at the close of its all-day session at the ASHAE Laboratory in Cleveland on May 14. Authorized and organized as an activity of the Committee on Research of the Society, the Conference attracted an attendance of over 60 engineers drawn from control manufacturers' personnel, consulting engineers, and contractor-users. The Conference was organized in response to an increasing demand for factual information regarding various aspects of controlability.

To open the session, Pres. E. R. Queer, University Park, Pa., called upon and presented *ASRE* Pres. H. F. Spoehrer, and then the Conference chairman, Second Vice Pres. Walter A. Grant, Syracuse, N. Y. Past Pres. P. B. Gordon, New York, N. Y., keynoted the panel. Past Pres. L. N. Hunter, Johnstown, Pa., spoke on controls in connection with heat exchange equipment. H. A. Lockhart, Morton Grove, Ill., covered the subject of energy and mass distribution, while W. P. Chapman, Milwaukee, Wis., had been assigned the subject of control production. T. F. Rockwell, Pittsburgh, Pa., spoke concerning controls from the point of view of the consultant-designer. E. R. Teske, Chicago, Ill., had as his topic the point of view of the contractor-user. Research needs in the field of control were set forth by E. F. Snyder, Jr., Minneapolis, Minn., present chairman of the ASHAE Committee on Research.

Much of the afternoon session was devoted to discussions of what the various panel members had said. The discussion brought to light much of the current thinking in the profession in connection with controls and their application, and especially the problem of relating the performance of control components to the planned performance of the system as a whole. It was felt that certain of these problems can be solved by suitable research.

The Conference was planned under the immediate direction of the Committee, whose members included: H. W. Alyea, Milwaukee; C. A. Gustafson, Skokie, Ill.; Past Pres. John W. James, Chicago; W. G. Young, Rockford, Ill.; and B. H. Jennings, Cleveland, director of research.

Panel speakers and presiding officers at the Control Conference. Seated (l. to r.) are E. R. Teske, H. W. Alyea, E. R. Queer, P. B. Gordon and W. P. Chapman. Standing (l. to r.) are Walter A. Grant, E. F. Snyder, Jr., H. A. Lockhart, T. F. Rockwell and L. N. Hunter.

Chapters Regional Committee Members and Alternates at the Region 2 Meeting, April 21. (*l. to r.*) *1st Row:* **Herbert Kreisman, E. P. Heckel, Jr., R. A. Urban, J. L. Frisse.** *2nd Row:* **K. J. Wagoner, D. S. Falk, A. A. Stutheit, R. D. Rodwell.** *3rd Row:* **L. P. Brehm, G. W. Vogel, A. O. Rocha, Jr., T. R. Walker, W. A. Schoonover, E. A. Sobolewski, C. P. Krantz, Robert Greenwald, R. J. Wonlkes, B. J. Walter, R. B. Walcott.**

Society Officers, Council Members and Wisconsin Chapter officers at the meeting of the Chapters Regional Committee for Region 2 in Milwaukee. (*l. to r.*) *Seated:* Walter A. Grant, 2nd vice president; E. R. Queer, president; A. J. Hess, 1st vice president; F. W. Hoffmann, assistant secretary. *2nd Row:* G. B. Priester and J. H. Ross (Council); H. W. Alyea and J. E. Peterson (Wisconsin Chapter). *3rd Row:* A. D. Papi, R. L. Murphy; P. N. Vinther of the Council; and W. L. Nerin.

EXCELLENT ATTENDANCE AT REGION 2 CHAPTERS REGIONAL COMMITTEE MEETING

A 100 percent representation from all chapters featured the meeting on April 21, of the Chapters Regional Committee Meeting of Region 2, held at the Plankington House, Milwaukee, Wis.

Many officers and Council members who had attended the Council, Regions Central and various committee meetings on April 19 and 20, at the Schroeder Hotel, Milwaukee, attended the Regional Meeting. They included: Pres. E. R. Queer, University Park, Pa.; 1st Vice Pres. A. J. Hess, Los Angeles, Calif.; 2nd Vice Pres. Walter A. Grant, Syracuse, N.Y.; A. B. Algren, Minneapolis, Minn.; Council members G. B. Priester, Baltimore, Md.; and J. H. Ross, Toronto, Ont.; Executive Secy. A. V. Hutchinson, New York, N.Y.: P. N. Vinther, Dallas, Tex., regional director of Region 6, and Fred Janssen, Denver, Colo., regional director of Region 3.

The meeting was conducted by 2nd Vice President Grant in the absence of regional director P. J. Marschall, North Chicago, Ill., who was out of the country on business. A. A. Stutheit of Wisconsin Chapter was named secretary of the meeting.

The morning session was given over to welcome comments by the host chapter (Wisconsin Chapter), a discussion of the proposed ASHAE-*ASRE* merger plan, with a discussion period led by President Queer and 1st Vice President Hess, as well as discussion on various chapter agenda items.

The luncheon featured a talk by 1st Vice President Hess on *Third Year of the Society's Regional Plan.* Following Mr. Hess's talk, a movie was shown on 1957 *Highlights of the Milwaukee Braves.*

At an Executive Session in the afternoon, D. S. Falk of Michigan Chapter was nominated member of the Nominating Committee for 1959. B. M. Kluge, Wisconsin Chapter, was nominated first alternate and R. J. Waalkes, Western Michigan Chapter, was nominated second alternate. An invitation to hold the 1959 Chapters Regional Committee Meeting of Region 2 in Dayton was extended by Miami Valley Chapter, and an alternate invitation was received from Western Michigan Chapter to hold the meeting in Grand Rapids, Mich.

A general discussion on Chapter Affairs covering publications, dues structure, meetings, speakers, membership, etc., concluded the meeting.

A social hour followed at the Plankington House, where more than 100, including officers and members of the host

Head table at Wisconsin Chapter Dinner, held during the April meeting of the Chapters Regional Committee for Region 2. (*l. to r.*) R. D. Rodwell, Wisconsin Chapter vice president; P. N. Vinther, Council member; A. J. Hess, 1st vice president; E. R. Queer, president; H. W. Alyea, president of Wisconsin Chapter; J. H. Ross, Council member; R. L. Murphy, Wisconsin Chapter general chairman; F. W. Hofmann, assistant secretary; A. A. Stutheit, Wisconsin Chapter secretary; Mehdi N. Bahmdori, a guest; and D. W. Nelsen, professor at the University of Wisconsin.

chapter, attended an excellent dinner. Dinner speaker was President Queer who discussed *General Conditions of the Society* and *Latest Developments of the Proposed* ASHAE-*ASRE Merger Plan.* This talk was followed by a second illustrated address by President Queer on *Industrial Ventilation of Underground Storage.*

Host chapter officers and members in charge of the program included: H. W. Alyea, chapter president, R. L. Murphy, program chairman, R. D. Rodwell, chapter vice president, J. E. Peterson, A. D. Papi and W. L. Norin.

QUEER REPRESENTS SOCIETY AT *EJC* MEETING

As representative of the Society, Pres. E. R. Queer, University Park, Pa., signed, along with representatives of other societies, a letter addressed to President Eisenhower reading:

"The undersigned representatives of all of the principal national engineering societies of the United States, having a total membership in excess of 300,000, hereby individually and collectively offer their full cooperation in the solution of the many technological problems that affect our security and economy."

The letter resulted from a suggestion made by House Majority Leader, Rep. J. W. McCormack, that an advisory group of engineers to serve the U. S. Government be established. The action took place at a dinner meeting held in New York, April 10.

NUNLIST IS WORTHINGTON CORP. VICE PRESIDENT

F. J. Nunlist, Milwaukee, Wis., for many years an active member of the Society, became group vice president of the air conditioning and refrigeration and Mueller Climatrol divisions of the Worthington Corp. The election of Mr. Nunlist was effective as of May 1. He will have headquarters at Harrison, N. J., and will coordinate the company's activities in the field of heating and cooling equipment. Mr. Nunlist has served on many Society committees and is a past president of the Wisconsin Chapter.

INCORPORATION OF *EJC*

For some time, plans have been in progress looking toward the incorporation of *Engineers Joint Council.* It has been announced that the State of New York has granted the right to incorporate, and action concerning it awaits the affirmative vote of two-thirds of *EJC* constituent member societies, of which ASHAE is one.

CROSBY RETIRES

It is announced that E. L. Crosby, long a member of the Society and active on numerous Society committees, retired on May 1 as an officer and director of the firm of Henry Adams, Inc., in baltimore. However, Mr. Crosby continues to serve the firm as a consultant and maintains his offices at the firm headquarters.

ACTIVITIES OF SOCIETY CHAPTERS

Spring is the season for meetings of the Regions Central Committees. The report of Region 2 can be found in this issue. Also the 72nd chapter of the Society was installed at Calgary, Alta., Canada, on April 29th. Other Society chapters through the United States and Canada reported holding many interesting meetings that featured technical and non-technical talks.

72nd Chapter Chartered at Calgary, Alta., Canada

The 72nd chapter of the AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS was inaugurated April 29, at the Beacon Hotel, Calgary, Alta., Can., with some 120 members and guests in attendance. Pres. E. R. Queer, University Park, Pa., presented the charter to the chapter president, H. W. Klassen.

W. G. Hole of Montreal, Regional Director of Region 7, opened the meeting and introduced the guests who included, besides President Queer, A. J. Hess, Los Angeles, Calif., Society 1st vice president; F. W. Hofmann, New York, N.Y., society assistant secretary; His Worship, Mayor MacKay of the City of Calgary; Hon. F. Colburn, minister without portfolio, Government of Alberta; Kenneth Cutts, assistant manager of Business Development, Canadian Bank of Commerce; Dr. R. M. Hardy, dean of the faculty of Engineering, University of Alberta; Charles Stollary, 1st vice president, *Association of Professional Engineers of Alberta;* Fred Perry, councilor, Calgary Branch, *Engineering Institute of Canada;* W. Milne, Calgary, *Southern Alberta Association of Architects.*

Mayor MacKay welcomed the group to Calgary. Mr. Cutts spoke on public relations. President Queer gave a coffee talk on *General Conditions of the Society — Latest Developments of the* ASHAE-*ASRE Merger Plan;* and dinner speaker was Regional Director Hole, who discussed *Development of* ASHAE *in Canada.* Mayor MacKay presented symbols of the Stampede City—white stetson hats—to President Queer, Vice President Hess and Assistant Secretary Hofmann.

Seventeen members of the Northern Alberta Chapter attended as well as two representatives from British Columbia Chapter.

Earlier in the day, President Queer and Regional Director Hole were greeted at the railroad station by a group in colorful regalia and were taken to luncheon in a chuck wagon. The fine work of the publicity committee of the Southern Alberta Chapter was evident when President Queer was the subject of a radio interview, which was broadcast twice over the local station.

F. PAUL ANDERSON AWARD

Committee announces that nominations for the F. Paul Anderson Medal for 1958 are invited. Any member of the Society is eligible for nomination. The award is made in recognition of work done or service performed in the field of heating, ventilating or air conditioning.

Nominations, together with a full statement of the candidates' qualifications and achievements, should be sent to the Committee at ASHAE Headquarters, 62 Worth St., New York 13, N.Y., prior to August 1, 1958.

F. PAUL ANDERSON (HONORS & AWARDS) COMMITTEE

A. J. HESS, *Chairman*

JOHN W. JAMES — N. H. PETERSON

C. H. PESTERFIELD — R. A. SHERMAN

E. F. SNYDER, JR. (*Ex Officio*)

The entire head table appeared on television as the officers received their ten-gallon hats from Mayor MacKay. The local press also carried stories on the Charter Meeting. The show, televised at the meeting, later was viewed by the group at a party at the home of H. W. Klassen, president of the new chapter.

At the business meeting during which the charter was presented to the chapter by President Queer, the gavel, a gift of Savannah Chapter, was presented by 1st Vice President Hess and the record books were presented by Assistant Secretary Hofmann.

The By-Laws were approved and the following officers installed: President — H. W. Klassen; Vice President — D. L. Ontonio; Secretary — P. M. Meis; Treasurer — W. R. Laing. Members of the *Board of Governors* are: E. W. Deeves, N. J. Howes, F. B. Thompson and E. H. Watson.

Mr. Ontonio and Mr. Meis handled the program for the meeting.

Ross Zumwalt, president of North Texas Chapter, chats with future engineer Joe Lynn at the annual dinner for Future Engineers sponsored by the Engineers Club of Dallas, with ASHAE sponsoring some of the 300 high school students attending. Each boy attended with a sponsor from his chosen future field

COMMITTEE INVITES NOMINATIONS FOR HONORARY MEMBERS AND FELLOWS

Your Committee announces that proposals for *Honorary Members* and *Fellows* should be filed with the Executive Secretary by August 1, 1958. The forms for proposals, approved by the Council, are available from the headquarters office of the Society upon request.

Your attention is called to the following statements from the By-Laws concerning the *qualifications* of *Honorary Members* and *Fellows* (**Article II,** *Section 3, (a) and (d)*):

(*a*) *Honorary Member.* An Honorary Member shall be a notable person of pre-eminent professional distinction.

(*d*) *Fellow.* A Fellow shall be a MEMBER who has attained unusual distinction in the arts relating to the sciences of heating, ventilating, cooling or air conditioning, or the allied arts and sciences, or in the teaching of major courses in said arts and sciences, or who by reason of invention, research, original work, or as an engineering executive on projects of unusual or important scope, has made substantial contribution to said arts and sciences, and who has attained the age of forty-five (45) years, and has been in good standing as a MEMBER for a period of at least ten (10) years prior to the date of his proposal for Fellow grade.

Attention is also directed to the provisions of the By-Laws concerning *elections, proposals* and *applications* (**Article II,** *Sections 4* and *5*):

Section 4. Elections. Membership in the Society and advancement in membership grade shall be by vote of the Council on proposals or applications, or as set forth below. A unanimous vote by secret ballot shall be required for election to Honorary Member grade. Fifteen (15) votes by secret ballot shall be required for election to Fellow. . . . . .

The grade of Honorary Member shall be conferred on no more than three (3) persons in any calendar year. The grade of Fellow shall be conferred on no more than ten (10) MEMBERS in any calendar year. No member of the Council shall be elected to Honorary Member or Fellow grade. . . . . .

Section 5. Proposals and Applications. Proposals and applications shall be on forms approved by the Council. Proposals for Honorary Member and Fellow grades shall be signed by no less than ten (10) MEMBERS, no more than five (5) of whom shall be members of the same Chapter of the Society. Members of the Council may not be proposers. . . . . .

Thus, any members who wish to make nominations should see that the forms giving their nominees' qualifications and attainments are completed and in the hands of the Executive Secretary by August 1st, so that he can submit them to the Committee for review and recommendation to the Council.

F. Paul Anderson (Honors & Awards) Committee

A. J. Hess, *Chairman*
John W. James — N. H. Peterson
C. H. Pesterfield — R. A. Sherman
E. F. Snyder, Jr. (*Ex Officio*)

JOURNAL SECTION

Technical Talks

A woman speaker recently addressed ARIZONA Chapter. Mrs. Olivia P. Burkey of the Chemical Solvent Co., Birmingham, Ala., discussed problems of water treating. • • • Society Pres. E. R. Queer recently led an interesting discussion on the proposed ASHAE-*ASRE* merger plan before ATLANTA Chapter. Representatives of *ASRE* were also present at the meeting. • • • Merle Baker, assistant professor of mechanical engineering and director of the Kentucky Research Foundation, University of Kentucky, discussed *Heat Pumps* before members of BLUEGRASS Chapter. An interesting discussion followed. • • • A lecture on *Pyroceram* illustrated by a five minute movie and samples of various products which have been developed using this new material was given by W. G. Bailey, New Products Division, Corning Glass Works, Corning, N. Y., before members of CENTRAL NEW YORK Chapter. • • • Guest speaker at a CONNECTICUT Chapter meeting was George Landgraff, vice president, Trion, Inc., McKees Rocks, Pa., who discussed *Test Procedures and Evaluation of Filters.* • • • A well received discussion on Gas Burners was heard by members of DELTA Chapter. The speaker was George Bergtholdt, Webster Engineering Co., Tulsa, Okla., who was given a standing ovation at the conclusion of the meeting. • • • A most interesting talk on the *Design and Application of Air Cooled Condensers* was given before members of FORT WORTH Chapter by S. Charles Segal, Kramer-Trenton Co., Trenton, N. J. • • • *Space Satellites* and *Space Travel* was the subject of a talk before members of IOWA Chapter by Prof. J. H. Senne, Civil Engineering Department, Iowa State College. • • • Society Pres. E. R. Queer discussed the proposed ASHAE-*ASRE* merger and later gave an illustrated talk on *Industrial Air Conditioning of Underground Storage* before members of JACKSONVILLE Chapter. • • • B. R. Small, staff engineer, Aluminum Company of America, Pittsburgh, Pa., discussed the Alcoa Building's heating and air conditioning system and highlighted the talk by showing a motion picture, *Aluminum on the Skyline*, before members of JOHNSTOWN Chapter. • • • Members of KANSAS CITY Chapter heard an interesting illustrated talk, *New Trends in Hot Water Heating*, by G. F. Carlson, Bell & Gossett Co., Morton Grove, Ill. • • • MANITOBA Chapter members recently heard an illuminating talk on steam traps by John Coates, general sales manager, Sarco Canada, Ltd., Toronto, Ont. • • • William Timmes, Dravo Corp., Pittsburgh, Pa., gave a most informative talk before members of MEMPHIS Chapter on gas heating systems, combination

gas and oil burners and control systems. The discussion was supplemented by a model gas and oil burner for demonstration purposes. • • • Vibration elimination was the subject of a discussion by D. H. Vance, vice president and executive engineer, Korfund Co., Long Island City, N. Y., before MIAMI VALLEY Chapter members. • • • Some 90 members and 30 guests heard a most interesting discussion on water conservation recently by Donald Cousins, manager, Merchandising Department, Marley Co., Kansas City, Mo. A lively question and answer period followed. • • • ONTARIO Chapter recently had a joint meeting with WESTERN NEW YORK Chapter. Approximately 50 members of the Ontario Chapter journeyed to Buffalo to visit the 400 hp Air Source Heat Pump Installation at Sylvania Electric Products, Inc. Following an inspection of this installation, a joint meeting of the two chapters was held at the University Club. The Ontario Chapter invited Western New York Chapter to visit the Ontario Chapter next year. G. C. Briley, application engineer, York Corp., Rochester, N. Y., gave an illustrated talk on the Heat Pump Installation at Sylvania. • • • *An Analysis of Schoolhouse Air Conditioning* was given before members of PHILADELPHIA Chapter, by S. W. Miller, John J. Nesbitt, Inc., Pittsburgh, Pa. • • • An informative discussion of Environment, People and Agricultural Animals was given before members of ST. LOUIS Chapter by Professor M. K. Fahnestock, Mechanical Engineering Department, University of Illinois. Professor Fahnestock's presentation provided many valuable ideas for air conditioning in the agricultural field as well as for human comfort. • • • *The Need for Protective Construction in the Nuclear Age* was the subject of a talk before SOUTHERN CALIFORNIA Chapter members. The speaker was Col. R. F. Lynch, director, Office of Civil Defense, Los Angeles, Calif. • • • H. E. Straub, research engineer, Titus Manufacturing Corp., Waterloo, Iowa, gave a most interesting talk on Residential Room Air Distribution before members of WESTERN MICHIGAN Chapter. His talk covered outlets in the ceiling, floor, high and low side wall with both horizontal and spreading type throw. Through the use of slides, he showed the effects different outlets had on primary air, total air and stagnant air for both heating and cooling.

Non-Technical Talks

Members of ARKANSAS Chapter recently enjoyed a field trip to the Justice Building, State Capitol Grounds, Little Rock, Ark., and studied the air conditioning system there. The group also heard P. N. Vinther, regional director of Region 6, give an excellent talk on the benefits, obligations and objectives of the Society and also discussed the proposed ASHAE-*ASRE* merger plan. • • • Members of OREGON Chapter recently heard an interesting discussion by Sherman Washburn, special reporter for KOIN-TV, Portland, Ore. Mr. Washburn showed a 30-min. movie entitled *How Now Brown Cloud*, an expose of the air pollution problem in Portland. • • • Members of TOLEDO Chapter recently heard a talk on *General Liability and Casualty Insurance* by R. M. Streeter, assistant manager, Cleveland office, Hartford Accident and Indemnity Co.

Speakers' Table at the Washington, D. C. Chapter meeting on April 5, held during the recent Chapters Regional Committee Meeting for Region 5 at which Washington, D. C. Chapter was the host. (*l. to r.*) G. B. Priester, R. J. Ruschell, H. J. Rush, Mrs. E. R. Queer, J. W. Morgan, President Queer, F. W. Hofmann, assistant secretary of ASHAE, and H. M. Hock, Federal Coal Mine Inspector, U. S. Bureau of Mines, who was the dinner speaker.

CANDIDATES FOR MEMBERSHIP

Listed here are the names of 71 men who are the candidates for membership or advancement in membership grade. Members are requested to assume their full share of responsibility of receiving these candidates into membership by advising the Executive Secretary before June 30, 1958, of any whose eligibility for membership is questioned. Unless such objection is made these candidates will be voted upon by the Council.

Note: **Advancement* †*Reinstatement*

Alabama (*Region* 5)

ALMOND, G. C.*, Engr., Shook & Fletcher Supply Co., Birmingham.

California (*Region* 4)

KLUGER, PAUL, Design Engr., Aerojet General Corp., Sacramento.

PHINNEY, H. W., Mech. Engr., Nack & Sunderland, Pasadena.

STROZEWSKI, C. S., Indus. Design Engr., Tegart Engineering, Culver City.

WELLS, N. W., Repr., Luppen & Hawley, Inc., Sacramento.

Connecticut (*Region* 1)

NEUENDORFFER, RICHARD, Supvsr., Fan Sec., Research & Dvlpt. Dept., Electric Boat Div., General Dynamics Corp., Groton.

Illinois (*Region* 2)

ARMSTRONG, J. D., Design Engr., Beling Engineering Consultants, Moline.

Iowa (*Region* 3)

O'NEIL, E. E., Sales Engr., Dunham-Bush, Inc., Des Moines.

Kansas (*Region* 3)

NEVINS, R. G.*, Prof., Head of Dept., Dept. of Mech. Engrg., Kansas State College, Manhattan.

Kentucky (*Region* 5)

BRIGGS, D. D., Supvsg. Engr., American Air Filter Co., Louisville.

RICHARDSON, R. R., Sales Repr., American-Standard, Louisville.

SAULSMAN, R. R., Sales Engr., York Corp., Sub. of Borg-Warner Corp., Fern Creek.

Louisiana (*Region* 5)

ALLEN, E. R., Supt. of Maint., Standard Brands, Inc., New Orleans.

Maryland (*Region* 5)

SCHLITZER, H. J.*, Proj. Engr.-Designer, William H. Thompson, Cons. Engr., Baltimore.

Massachusetts (*Region* 1)

GARLAND, J. A., Sales Engr., The John Bonner Co., Inc., Cambridge.

Michigan (*Region* 2)

PARTLOW, C. A., Sales Engr., The Trane Co., Lansing.

Minnesota (*Region* 3)

OSLUND, J. J., Sales Engr., Westinghouse Electric Corp., Minneapolis.

Mississippi (*Region* 5)

KING, W. F., Br. Mgr., F. J. Evans Engineering, Jackson.

Missouri (*Region* 3)

MARTIN, C. B., Mgr. of Constr., Industrial Insulation Div., Johns-Mansville Sales Corp., Kansas City.

Montana (*Region* 3)

KILBY, W. C.†, Mech. Engr., McIver, Hess, & Haugsjaa, Great Falls.

Nebraska (*Region* 3)

BOLDRA, R. A., Mech. Designer, Nance Engineering, Inc., Omaha.

New Jersey (*Region* 1)

WILSON, J. M., Jr., Product Mgr., Warren Webster & Co., Camden.

New York (*Region* 1)

GRIFFIN, B. H.†, Engr., Estimator, Horowitz Bros. Inc., Syosset.

KOOP, J. F., Engr., Phillips Cooling Tower Corp., Brooklyn.

LLOYD, R. H., Mech. Engr., Cannon, Thiele, Betz & Cannon, Niagara Falls.

RAINER, GEORGE, Design Engr., Jaros Baum & Bolles, New York.

RAPP, H. E., Tech. Dir., Insul-Fil Co., Div. of Miracle Adhesive Corp., Bellmore, L. I.

ZAHRADNIK, A. J., Sr. Mech. Engr., Western Electric Co., Inc., New York.

Ohio (*Region* 2)

BARBARA, R. B.*, Vice Pres., E. J. Nolan Corp., Cincinnati.

BARTON, J. W., Sales Engr., York Corp., Cleveland.

BROCKMAN, W. M., Pres., Wm. Brockman & Sons, Inc., Dayton.

SCHUUR, C. W., Sales Engr., Herman Nelson Div., American Air Filter Co., Inc., Cleveland.

ZILLICK, P. P.*, Sales Engr., R. E. Kramig Co., Cincinnati.

Oklahoma (*Region* 6)

BRAUN, G. C., Engr., Natkin & Co., Tulsa.

GAYDEN, H. P., Jr., Sales Engr., A-C. Div., Westinghouse Electric Corp., Oklahoma City.

PASCHAL, S. B., Br. Mgr., J. P. Ashcraft Co., Inc., Oklahoma City.

STEINMANN, R. H., Dist. Repr., A-C. Div., Worthington Corp., Oklahoma City.

Pennsylvania (*Region* 1)

GASTON, W. C., Engr.-in-Training, The H. F. Lenz Co., Johnstown.

HAZELL, R. A.*, Mgr., Canadian Br., National-U. S. Radiator Corp., Johnstown.

MADDEN, F. P., Partner, Madden Boiler Works, Hollidaysburg.

MOWRER, P. A., Asst. Mgr., Phila. Br., Weil-McLain Co., Philadelphia.

STOCKWELL, P. R., Eastern Sales Mgr., Weil-McLain Co., Philadelphia.

Rhode Island (*Region* 1)

HULL, R. F., Mgr., Heat Exchanger Div., General Fittings Co., East Greenwich.

MACLEAN, J. K.*, Owner, John K. MacLean Co., Providence.

Tennessee (*Region* 5)

DOUGLASS, N. L., Jr., Design Engr., Union Carbide Nuclear Co., Oak Ridge.

RIDINGS, D. F., Jr., Adv. & Sales Prom. Mgr., Blue Ridge Glass Corp., Kingsport.

Texas (*Region* 6)

WASIK, J. F., Asst. Sales Mgr., Worth Chemical Products Co., Fort Worth.

Virginia (*Region* 5)

SIGGELIN, K. G. A.*, Vice Pres., Engrg., Desomatic Products, Inc., Falls Church.

Washington (*Region* 4)

WALSH, W. J., Jr.†, Mgr., Pacific Monitor, Seattle.

Wisconsin (*Region* 2)

LATUS, E. A., Plt. Layout Engr., Electronic Div., General Motors, A. C. Spark Plug, Milwaukee.

RUCINSKI, A. M., Plt. Layout Designer, Div. General Motors Corp., A. C. Spark Plug, Milwaukee.

Canada (*Region* 7)

BELL, D. C., Sales Engr., R. L. Brens & Son, Ltd., Calgary, Alta.

COULTER, P. E., Tech. Dir., National Warm Air Heating & Air Conditioning Association of Canada, Toronto, Ont.

DAW, A. F., Supvsr., P. W. Donnelly, Trenton, Ont.

LEVINE, SEYMOUR, Con. Engr.; Asst. Prof., Sir George Williams College, Montreal, Que.

MCADAM, G. B., Archt., Rule Wynn & Rule, Calgary, Alta.

MAYSKY, JOHN, Engr., Public Works Building Branch, Edmonton, Alta.

NOAKES, C. T., Pres., Noakes Equipment Sales, Ltd., Toronto, Ont.

RAHME, R. W., Calgary Br. Mgr., Carrier Engineering, Ltd., Calgary, Alta.

ROSS, J. W., Sales Tech., Masdom Corp., Montreal, Que.

SCOTT, R. P., Architectural Supt., Ross Patterson Townsend & Fish, Montreal, Que.

SOICHER, J. A., Group Leader Mech. Services, Foundation of Canada Engineering Corp., Ltd., Montreal, Que.

STEVENSON, J. A., Sales Specialist, Canadian General Electric Co., Ltd., Montreal, Que.

STURGEON, W. C., Htg. Tech., Dept. of Northern Affairs, Ft. Smith, N.W.T.

JOURNAL SECTION

TOMS, G. C.*, Mech. Cons., Wilson & Newton, Toronto, Ont.

VANCE, E. J., Pres., Comfort Systems (Hamilton), Ltd., Hamilton, Ont.

WOLFE, W. W., Asst. Utilization Engr., Canadian Western Natural Gas Co., Calgary, Alta.

WOOLLEY, D. J., Admin. Supvsr., The Winnipeg Supply & Fuel Co., Ltd., Winnipeg, Man.

Egypt

MANSOUR, ALBERT, Mgr. Refrig. & A-C. Dept., Tractor & Engineering Co., SAE, Cairo.

France

PANSARD, JEAN, Mgr. A-C. Div., Dept. Climatisation, Ideal-Standard, S.A., Paris.

Switzerland

GOERG, R. A.*, Gen. Mgr., Technicair S.A., Geneva.

OBITUARIES

FRED E. GROSVOLD
Eau Claire, Wis.

Fred E. Grosvold, 81, of the Wisconsin Chapter of the Society, died recently. He had been a member of the Society for 30 years.

Born in Copenhagen, Denmark, Mr. Grosvold was brought to this country at an early age. After a public school education he worked for several firms and then founded the F. E. Grosvold Heating and Plumbing Co., which has been in operation in Eau Claire for more than 40 years.

CARL R. MATTHEWS
Westlake, Ohio

Carl R. Matthews, 55, of the Northern Ohio Chapter of the Society, died on April 3. He had been with the Minneapolis-Honeywell Regulator Co. for over 34 years, serving mainly with the installation and sales engineering departments.

Mr. Matthews joined the Society in 1944. He was also in the Halcyon Lodge of the Masonic Order. Surviving are a widow and a son, Carl, Jr.

ALFRED E. McGRUER
Montreal, Que., Canada

Alfred E. McGruer, 57, of the Montreal Chapter, died this spring. He had been a member of the Society since 1945.

Born in Barrow, England, Mr. McGruer became a Canadian citizen and had been an engineer with the Canadian Pacific Railway since 1926. He became chief electrical engineer in 1953. He was also a member of the *Institute of Power Engineers.*

ROBERT W. POWERS
Bennettsville, S.C.

Robert W. Powers, 39, a member of the South Carolina Chapter of the Society, died in a plane crash in North Carolina on March 29.

Mr. Powers had been a member of the Society since 1941. A graduate of Washington and Lee University, he served in the Navy during World War II. After the war he was with the Army Engineers for two years, helping with the construction of military installations. He then joined his father's firm, the J. L. Powers Plumbing and Heating Co., and was general manager of the company at the time of his death.

Active in civic affairs, Mr. Powers had served on the city council and was mayor of Bennettsville prior to his death. His survivors include his widow and five children.

EDWARD L. STAMMER
St. Louis, Mo.

Edward L. Stammer, 88, retired superintendent of heating and ventilating for the St. Louis Board of Education, died recently. Mr. Stammer was a member of the St. Louis Chapter and had been in the Society since 1919. He was elected to Life Membership in 1941.

HARVEY O. WILLIAMS
Houston, Tex.

Harvey O. Williams, 65, of the South Texas Chapter of the Society, died on February 28. He had been a member of the Society since 1945.

Mr. Williams was a field service engineer of the A. M. Byers Co. He is survived by his wife, Edith.

AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS

Headquarters Office
62 Worth St., New York 13, N.Y.
Tel: BArclay 7-6262

(For names of Society Officers see p. 138)

Research Laboratory
7218 Euclid Ave., Cleveland 3, Ohio
Tel: UTah 1-6161

Committee on Research and Its Technical Advisory Committees

The research program of the Society is under the guidance of the Committee on Research — a General Committee — elected by the vote of Society membership. That Committee appoints Technical Advisory Committees as necessary and directs their activities. Listed below are the names of the current members of these committees.

Committee on Research

E. F. Snyder, Jr., Chairman — R. C. Jordan, Vice Chairman

Three Years: P. R. Achenbach, S. F. Gilman, N. B. Hutcheon, R. M. Stern, H. E. Ziel.

Two Years: D. D'Eustachio, E. S. Howarth, H. R. Limbacher, E. F. Snyder, Jr., J. I. Trimble.

One Year: F. K. Hick, M.D., R. C. Jordan, H. A. Lockhart, Arthur Nutting.

Research Executive: E. F. Snyder, Jr., Chairman; R. C. Jordan, Vice Chairman; D. D'Eustachio, N. B. Hutcheon, H. L. Lockhart.

Long-Range Research Program: R. C. Jordan, Chairman; H. A. Lockhart, Vice Chairman; N. B. Hutcheon, Arthur Nutting, J. I. Trimble.

1958 Technical Advisory Committees

Air Cleaning: W. C. L. Hemeon, Chairman; Arthur Nutting*, Vice Chairman; P. R. Achenbach, C. W. Coblentz, S. F. Duncan, O. C. Eliason, P. E. Engle, B. L. Evans, M. W. Keyes, R. C. Lower, C. H. Meyer, C. S. Stephens, J. R. Swanton, Jr.

Air Distribution: P. A. Argentieri, Chairman; H. R. Limbacher*, Vice Chairman; J. V. Borry, J. C. Davidson, F. B. Holgate, W. O. Huetner, W. W. Kennedy, W. B. Kirk, Alfred Koestel, E. J. Kurek, R. D. Madison, R. G. Nevins, H. B. Nottage, H. M. Patrick, L. R. Phillips, N. S. Shatatoff, H. E. Straub, R. D. Tutt, Fred Vogt, Hrant Yousoufian.

Combustion: M. W. McRae, Chairman; H. R. Limbacher*, Vice Chairman; J. J. Boland, K. T. Davis, W. B. Kirk, D. W. Locklin, A. A. Marks, E. M. Mittendorff, W. M. Myler, Jr., C. H. Neiman, Jr., E. O. Olson, W. W. Popyk, R. W. Sage, D. L. Wooden.

Evaporative Cooling: S. F. Duncan, Chairman; R. M. Stern*, Vice Chairman; R. S. Ash, D. R. Baker, H. S. Dutcher, Leo Hungerford, L. C. Pellegrini, C. W. Pollock, C. B. Rowe, W. T. Smith, B. H. Spurlock, Jr., J. R. Watt.

Heat Pump: P. R. Achenbach*, Chairman; R. C. Jordan*, Vice Chairman; E. R. Ambrose, D. N. Berks, G. L. Biehn, Warren Cheatham, R. C. Chewning, S. F. Graziano, W. L. McGrath, W. E. Nanes.

Heat Transfer Through Fenestration: D. D'Eustachio*, Chairman; R. C. Jordan*, Vice Chairman; T. C. Carson, O. D. Englehart, W. B. Ewing, C. W. Kelly, J. B. Leavy, E. C. Miles, Bruno Morabito, F. W. Mowrey, G. H. Munger, O. L. Pierson, D. J. Vild, O. F. Wenzler, C. J. Youngblood.

*Member of Committee on Research.

Heating and Air Conditioning Loads: H. T. Gilkey, Chairman; P. R. Achenbach*, Vice Chairman; R. T. Baum, R. G. Chapman, C. W. Coblentz, R. A. Gonzalez, W. G. Kane, T. C. Min, G. R. Munger, I. A. Naman, T. F. Rockwell, A. M. Simpson, D. B. Turkington, A. Grant Wilson, W. R. Yeary.

Hot Water and Steam Heating: A. O. Roche, Jr., Chairman; H. E. Ziel*, Vice Chairman; G. F. Carlson, J. R. Carroll, J. W. James, D. L. Lindsay, R. B. Luhnow, Jr., E. M. Mittendorff, J. D. Pierce, K. O. Schlentner, L. E. Seeley, R. M. Stern*, E. R. Teske, N. E. Westphal.

Industrial Environment: Arthur Nutting*, Chairman; J. H. Clarke, Vice Chairman; Lucien Brouha, F. N. Calhoon, K. J. Caplan, C. S. Cave, A. S. Gates, Jr., Robert Greenwald, T. F. Hatch, E. C. Hungate, J. M. Kane, H. P. Kaulfuss, R. L. Kuehner, B. R. Small, R. P. Warren.

Insulation: G. R. Munger, Chairman; H. A. Lockhart*, Vice Chairman; J. M. Barnhart, W. J. Binder, H. C. Brown, Jr., G. A. Erickson, D. A. Huebner, W. T. Jones, F. A. Joy, M. W. Keyes, R. J. O'Heir, F. E. Parsons, E. L. Perrine, C. F. Pridmore, K. M. Ritchie, Laurence Shuman, L. A. Staebler, W. C. Turner.

Odors: H. L. Barnebey, Chairman; J. I. Trimble*, Vice Chairman; C. J. D'Angio, C. F. Kayan, R. L. Kuehner, Lawrence Macrow, Douglas E. Melzard, P. J. Messer, Sherman Ross, S. B. Smith, L. A. Staebler, R. D. Touton, Warren Viessman.

Plant and Animal Husbandry: H. A. Lockhart*, Chairman; T. E. Bond, M. K. Fahnestock, A. J. Hess, C. F. Kelly, G. L. Nelson, R. E. Stewart, H. J. Thompson, H. E. Ziel*.

Physiological Research and Human Comfort: John Everetts, Jr., Chairman; F. K. Hick*, M.D., Vice Chairman; Thomas Bedford, H. S. Belding, Lucien Brouha, M. K. Fahnestock, T. F. Hatch, L. N. Hunter, N. B. Hutcheon*, John W. James, P. J. Marschall, R. G. Nevins, P. W. Wyckoff, C. P. Yaglou.

Solar Energy Utilization: R. C. Jordan*, Chairman; M. L. Ghai, Vice Chairman; E. R. Ambrose, F. R. Ellenberger, N. B. Hutcheon*, M. L. Khanna, G. O. G. Löf, Gunnar Pleijel, Maria Telkes, J. L. Threlkeld, G. T. Ward, L. F. Yissar.

Sorption: G. C. F. Asker, Chairman; E. S. Howarth*; Vice Chairman; H. L. Barnebey, W. P. Cummings, W. E. Emley, Jr., R. J. Getty, R. R. Goll, T. E. Gravenstreter, Anthony Hass, G. A. Kelley, E. R. McLaughlin, R. M. Milton, H. E. Parker, W. L. Ross, G. L. Simpson.

Sound and Vibration Control: A. F. Hubbard, Chairman; D. D'Eustachio*, Vice Chairman; C. M. Ashley, Sydney Baken, J. B. Chaddock, R. A. Gerlitz, J. B. Graham, R. N. Hamme, John Harker, C. R. Hiers, F. B. Holgate, F. D. Joesting, D. H. Krans, R. D. Lemmerman, R. E. Parker, G. J. Sanders, R. M. Towne, R. J. Wells.

Thermal Circuits: S. F. Gilman*, Chairman; Harry Buchberg, Vice Chairman; W. R. Brisken, N. R. Gay, C. F. Kayan, C. B. Monk, Jr., L. W. Nelson, H. B. Nottage, K. R. Solvason, H. B. Vincent.

Weather Data: W. L. Holladay, Chairman; P. R. Achenbach*, James Bricker, D. T. Donovan, John Everetts, Jr., D. L. Fiske, J. B. Graham, W. S. Harris, W. J. Radle, W. T. Smith, H. C. S. Thom.

Society Organization Personnel

Council and Council Committees, Advisory Board, General and Special Committees: The latest list of the Council and Council Committees, Advisory Board and General Committees appears in the February 1958 JOURNAL SECTION on page 146

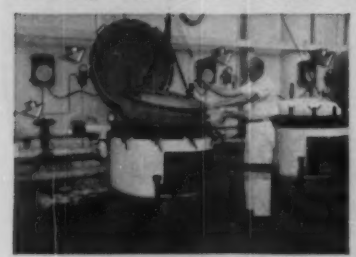
Nominating Committee: This committee's membership is fixed by the By-Laws. The latest listing appears in the February 1958 JOURNAL SECTION on page 146

Society Regional Organization: The 1958 listing of the names of the Regional Directors and of the members of the Chapters Regional Committees appears in the May 1958 issue on page 194

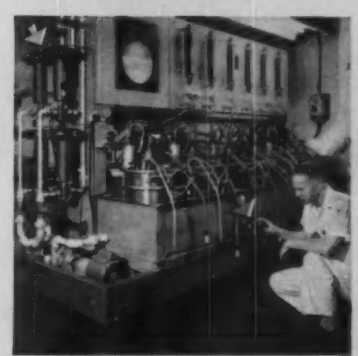
Research Committees: The research program is under the guidance of the Committee on Research — a General Committee. The Committee on Research appoints Technical Advisory Committees as needed. The 1958 personnel appear above.

Society Chapters and Branches: The Society has chartered 72 Chapters, 1 Overseas Branch, and 6 Student Branches. These groups elect their officers and governing boards. A list of the presidents and secretaries appears in the May 1958 issue on pages 195-196

Shaker room and incubator in Fermentation Department. Powers Temperature Recording Controllers are used here.



Ampoule Sterilizers regulated by Powers No. 252 Pressure Regulators and Valves.



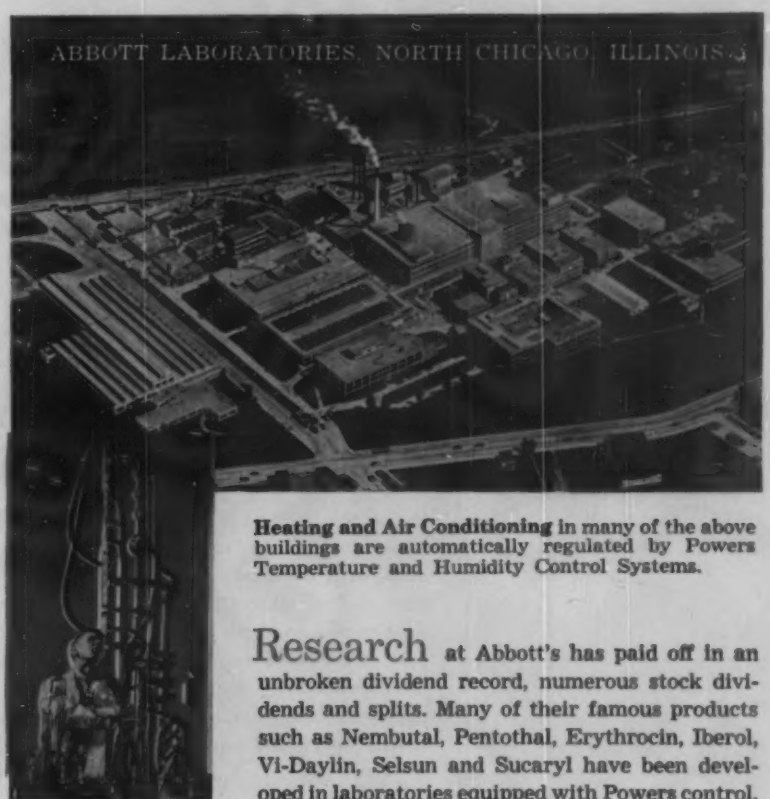
Fermentation process in research pilot plant controlled by Powers ACCRITEM Regulators and FLOWRITE Valves.

A few of the many vacuum dryers equipped with Powers Temperature Controllers.

Below: Air Conditioned Room for Board of Directors and executive conferences.

POWERS *AUTOMATIC* temperature, humidity and pressure control

.... helps Abbott Laboratories bring better health to millions



Heating and Air Conditioning in many of the above buildings are automatically regulated by Powers Temperature and Humidity Control Systems.

Research at Abbott's has paid off in an unbroken dividend record, numerous stock dividends and splits. Many of their famous products such as Nembutal, Pentothal, Erythrocin, Iberol, Vi-Daylin, Selsun and Sucaryl have been developed in laboratories equipped with Powers control.

Versatility of Powers control used at Abbott's is indicated by some of the applications shown here and in the following installations: Air conditioning control systems for auditorium with 900 seating capacity, executive offices and dining room, cafeteria and animal rooms; also controls for tablet machines, demineralized water heaters, autoclaves and many other applications.

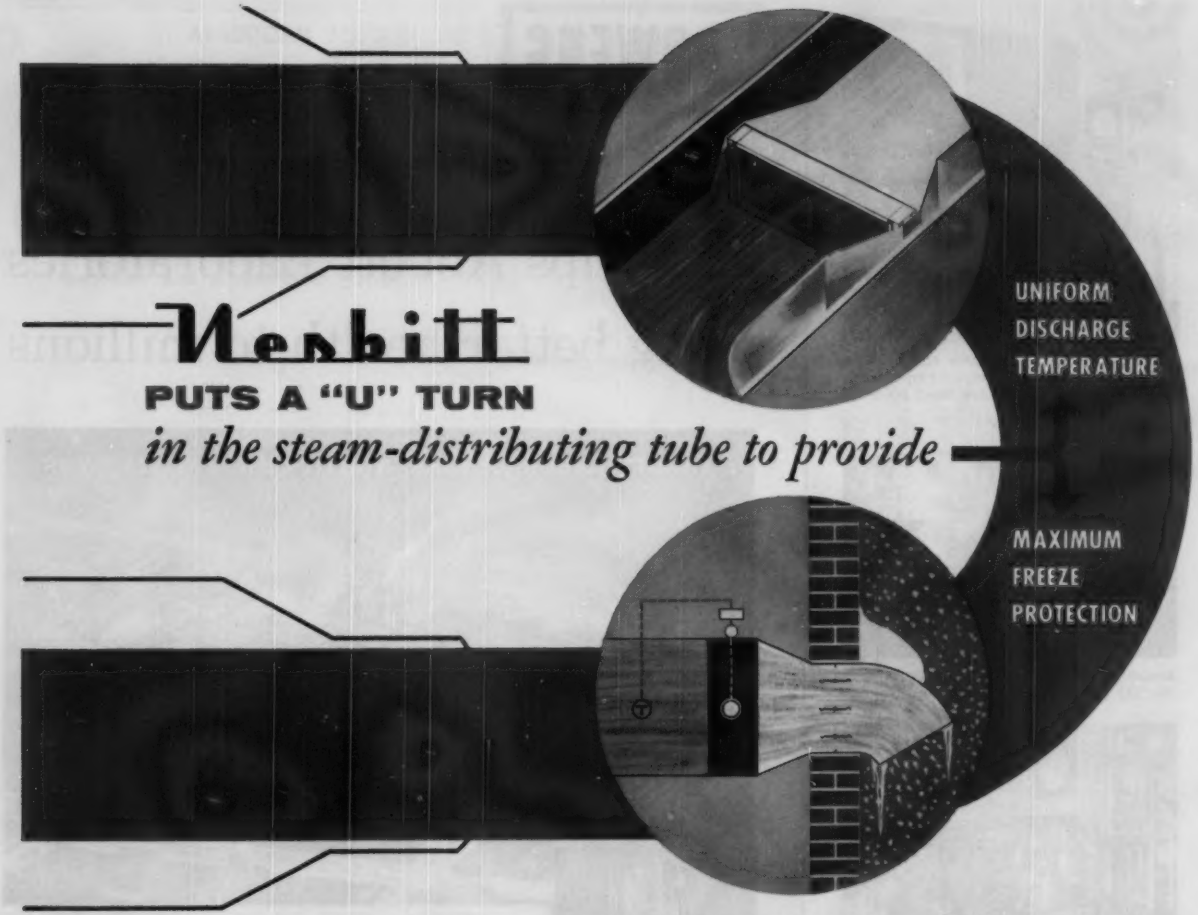
When you need automatic control for temperature, humidity or pressure, call your nearest Powers office or write us direct. An experienced Powers engineer will gladly help you select the right type of control for your requirements.

(ctfa)

THE POWERS REGULATOR COMPANY

SKOKIE, ILLINOIS | *Offices in chief cities in U.S.A., Canada and Mexico*

Over 60 years of Automatic Temperature and Humidity Control



Nesbitt

PUTS A "U" TURN

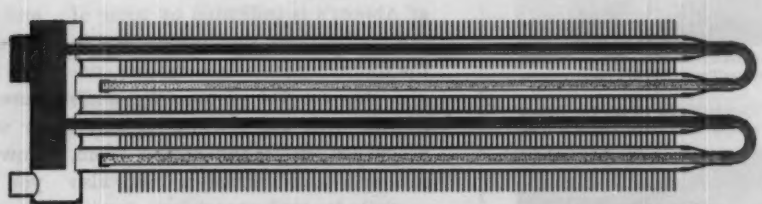
in the steam-distributing tube to provide

The unique "U" turn in the design of Series T Surface with TROMBONE steam distributing tubes doubles the surface area over which steam quantities are distributed. This achieves a uniformity of steam distribution unmatched by conventional arrangements. Because the exclusive Nesbitt TROMBONE construction results in only one half the normal number of connections to a supply header, the quantity of steam supplied to the first leg of each TROMBONE distributing tube is double what it would be in a conventional design. This higher rate of steam per distributing tube is particularly important when a small steam quantity is being supplied. The same quantity of steam will travel twice as far along the surface length and contact twice the surface area.

Net results: Uniform discharge temperatures and *maximum* freeze protection over the entire capacity range—from 100% down to the smallest practicable supply of low pressure steam under valve control.

Nesbitt Trombone Surface:

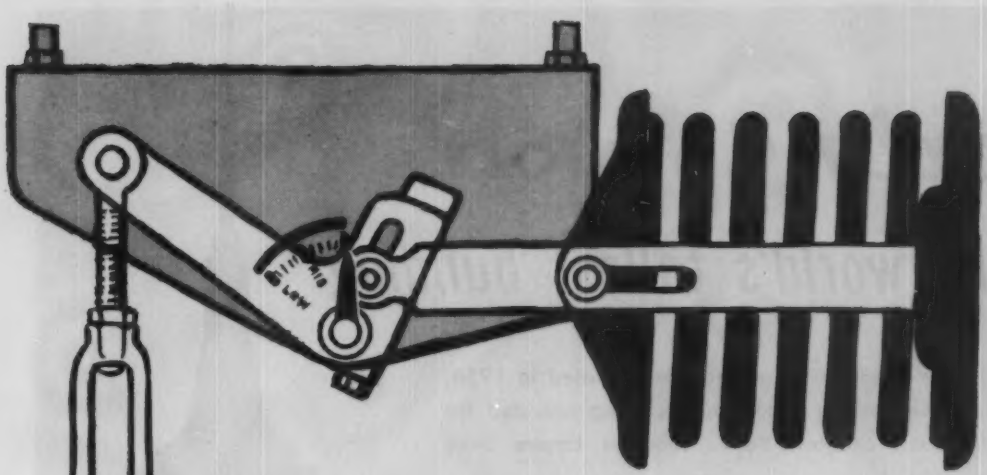
Note how the steam is apportioned to *every other* tube. The *same* steam quantity goes *twice as far* in each tube. Even small steam quantities are distributed over the full surface length. Results: uniform final temperatures, full length of coil; freeze protection; perfect control with modulating valves.



Nesbitt HEATING SURFACE

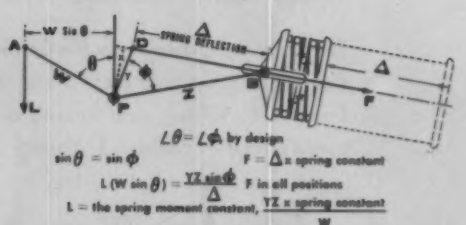
WITH THE TROMBONE STEAM DISTRIBUTING TUBES

Made and sold by John J. Nesbitt, Inc., Phila. 36, Pa. • Ask for publication 305-1



Mathematically Perfect Pipe Support!

The exclusive geometric design of the Grinnell Constant Support Hanger balances the moment of the vertically shifting load with a mathematically equal spring moment at every point throughout the full range of travel.



GRINNELL CONSTANT SUPPORT HANGERS may be adjusted over a 70% range of load carrying capacity, as indicated by the divisions on the load scale. When factory-adjusted to a specified load within this range, there always remains not less than 10% for additional field adjustment.

Compact design, resulting in small size for the load supported, makes Grinnell Constant Support Hangers easy to install—allows their use where only limited head room and space for close nesting are available. Simplicity of design makes these hangers easy to maintain.

Grinnell designs, manufactures and supplies pipe hangers and supports for every piping requirement.

In addition, Grinnell offers the services of trained field representatives and design services for consulting engineering firms. Contact Grinnell for your future hanger requirements.

Only Grinnell Hangers provide true constant support, plus these features:

- 5 frame sizes provide a range of travel from 1½ inches to 12 inches and support loads from 30 to 32,260 pounds.
- Load deflection curve is a horizontal straight line, at every setting on the load adjustment scale.
- Antifriction needle roller bearings are provided at all critical pivot points.
- Low ratio between spring force and supported load reduces friction, permits smaller size hangers for loads carried.
- Travel stop is a permanent attachment — always available for temporary use to set hanger into nonoperative position for underload or overload.

GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

Marlo Comfort

for the world's tallest building

Under an air conditioning program inaugurated in 1956, a comfortable working atmosphere is being provided for 25,000 tenants of New York's fabulous Empire State Building.

In the latest phase of the 5250-ton cooling job, Marlo central station units are being installed. The ceiling type units, with various capacities, are being installed in suspended-acoustic ceilings for concealed comfort conditioning.

The building is owned by the Empire State Building Corporation. Consulting Engineer for the Marlo units was The Firm of Edward E. Ashley, and among air conditioning contractors are: Kennedy-Scheidel & Young
Riggs Distler & Co., Inc.
Almirall & Co., Inc.
Wolff & Munier, Inc.
Thermodyne Corporation
all of New York City

One of the 120 Marlo central station air conditioning units installed in the Empire State Building. Units will be concealed by suspended ceilings.

MARLO CO

SAINT LOUIS 11, MISSOURI

Quality Air Conditioning and Heat Transfer Equipment Since 1925

"This sheet has just the right stiffness and ductility"

He's talking about a sheet of Bethcon galvanized steel, and his enthusiasm is shared by an ever-growing number of sheet-metal workers.

Bethcon has that very desirable combination of stiffness and ductility because of Bethlehem's up-to-the-minute continuous galvanizing lines, which include a continuous annealing process. This treatment turns out sheets which are easy to work into a strong, rigid sheet-metal product.

Bethlehem's continuous galvanizing process bonds the zinc to the steel so tightly that it virtually eliminates peeling or cracking of the coating. Even when you double the sheet back on itself, the zinc stays put. The coating is uniform, too, both in appearance and in thickness. Since a Bethcon sheet has no drip end, it has no bothersome bead.

You can order Bethcon in 13-gage and lighter, in either plain open-hearth or copper-bearing steel. A Bethlehem representative will gladly call to discuss your sheet-metal operations with you, and to give additional information about Bethcon. Just call or write to the Bethlehem sales office nearest you, or write to the address below.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation.

BETHLEHEM STEEL

BETHLEHEM STEEL

JENKINS PRACTICAL PIPING LAYOUTS

81

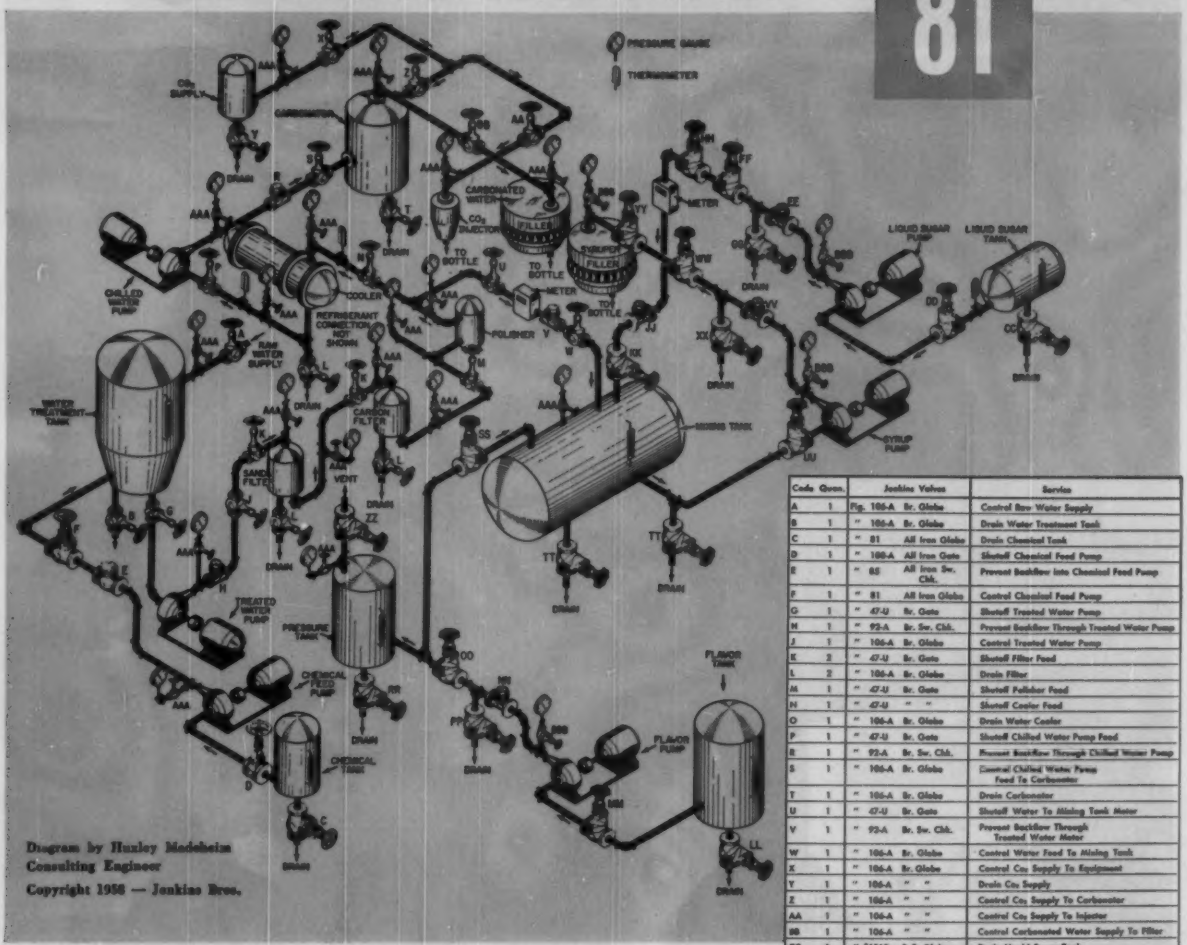


Diagram by Huxley Madeheim
Consulting Engineer

Copyright 1958 — Jenkins Bros.

Code	Quan.	Jenkins Valves	Service
A	1	Fig. 106-A Br. Globe	Control Raw Water Supply
B	1	" 106-A Br. Globe	Drain Water Treatment Tank
C	1	" 81 All Iron Globe	Drain Chemical Tank
D	1	" 108-A All Iron Gate	Shutoff Chemical Feed Pump
E	1	" 85 All Iron Sw. Chk.	Prevent Backflow into Chemical Feed Pump
F	1	" 81 All Iron Globe	Control Chemical Feed Pump
G	1	" 47-U Br. Gate	Shutoff Treated Water Pump
H	1	" 92-A Br. Sw. Chk.	Prevent Backflow Through Treated Water Pump
J	1	" 106-A Br. Globe	Control Treated Water Pump
K	2	" 47-U Br. Gate	Shutoff Filter Feed
L	2	" 106-A Br. Globe	Drain Filter
M	1	" 47-U Br. Gate	Shutoff Polisher Feed
N	1	" 47-U " "	Shutoff Cooler Feed
O	1	" 106-A Br. Globe	Drain Water Cooler
P	1	" 47-U Br. Gate	Shutoff Chilled Water Pump Feed
R	1	" 92-A Br. Sw. Chk.	Prevent Backflow Through Chilled Water Pump
S	1	" 106-A Br. Globe	Control Chilled Water Pump Feed To Carbonator
T	1	" 106-A Br. Globe	Drain Carbonator
U	1	" 47-U Br. Gate	Shutoff Water To Mixing Tank Meter
V	1	" 92-A Br. Sw. Chk.	Prevent Backflow Through Treated Water Meter
W	1	" 106-A Br. Globe	Control Water Feed To Mixing Tank
X	1	" 106-A Br. Globe	Control CO_2 Supply To Equipment
Y	1	" 106-A " "	Drain CO_2 Supply
Z	1	" 106-A " "	Control CO_2 Supply To Carbonator
AA	1	" 106-A " "	Control CO_2 Supply To Injector
BB	1	" 106-A " "	Control Carbonated Water Supply To Filler
CC	1	" *1313 S. S. Globe	Drain Liquid Sugar Tank
DD	1	" 1303 S. S. Gate	Shutoff Liquid Sugar Pump
EE	1	" 1329 S. S. Sw. Chk.	Prevent Backflow Through Liquid Sugar Pump
FF	1	" *1313 S. S. Globe	Control Liquid Sugar Pump
GG	1	" *1313 " "	Drain Liquid Sugar Line
HH	1	" 1303 S. S. Gate	Shutoff Liquid Sugar To Mixing Tank Meter
JJ	1	" 1329 S. S. Sw. Chk.	Prevent Backflow Through Liquid Sugar Meter
KK	1	" *1313 S. S. Globe	Control Liquid Sugar Feed To Mixing Tank
LL	1	" *1313 " "	Drain Flavor Tank
MM	1	" 1303 S. S. Gate	Shutoff Flavor Pump
NN	1	" 1329 S.S. Sw. Chk.	Prevent Backflow Through Flavor Pump
OO	1	" *1313 S. S. Globe	Control Flavor Pump
PP	1	" *1313 " "	Drain Flavor Line
RR	1	" *1313 " "	Drain Pressure Tank
SS	1	" *1313 " "	Control Flavor Feed To Mixing Tank
TT	2	" *1313 " "	Drain Mixing Tank
UU	1	" 1303 S. S. Gate	Shutoff Syrup Pump
VV	1	" 1329 S. S. Sw. Chk.	Prevent Backflow Through Syrup Pump
WW	1	" *1313 S. S. Globe	Control Syrup Pump
XX	1	" *1313 " "	Drain Syrup Line
YY	1	" *1313 " "	Control Syrup Supply To Syruper
ZZ	1	" *1313 " "	Vent From Pressure Tank
AAA	18	" 106-A Br. Globe	Control Pressure Gage
BBB	6	" 1312 S. S. Globe	" " "

*Or Fig. 1317-A, Multiple Bolted Bonnet Globe

How to plan piping connections for

A CARBONATED SOFT DRINK BOTTLING PLANT

Preparation and bottling of soft drinks, **requires a supply of treated water for diluting concentrated flavors in the mixing tank, thus making the syrup which is fed into bottles or cans by the syruper. Another operation carbonates water and feeds it into the bottles as the second ingredient. This layout also may be used for a "pop"** ***canning*** **plant, by changing the connections out of the three fillers.**

The water treatment system **here is typical. Bottles (or cans) are first filled with syrup from the mixing tank, then filled with carbonated water and, just before closure, injected with carbon dioxide gas to eliminate air.**

Water treatment lines **are red brass or copper with bronze valves and bronze-fitted pumps. The chemical line is controlled with all-iron valves to minimize effects of alkali corrosion. Stainless steel liquid sugar and flavor lines have stainless steel valves.**

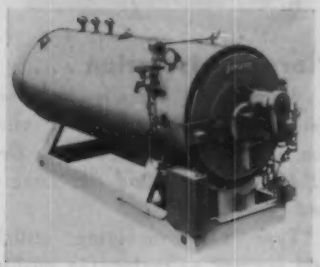
Either the Jenkins Fig. 1317-A Globe Valve **or Fig. 1313 Twin Bolt Body Globe Valve (shown in the layout) is recommended. Jenkins Fig. 1317-A has the advantage of a multiple bolted body-bonnet joint which assures absolute tightness yet permits easy dismantling for cleaning or renewal of parts.**

For details of valves to suit varying conditions see Jenkins Catalog. Consultation with accredited piping engineers and contractors is recommended when planning any piping system. Jenkins Bros., 100 Park Ave., New York 17.

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
JENKINS SINCE 1864
Jenkins Bros.
Sold Through Leading Distributors Everywhere

EQUIPMENT DEVELOPMENTS . . .

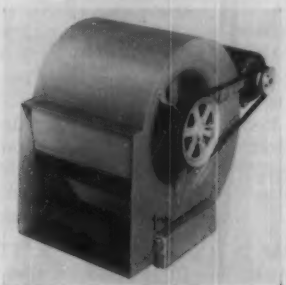
For reviews of Recent Trade Literature see Page 212



Packaged Boilers . . .

. . .developed to give 5 sq ft of heating surface per boiler hp—*Superior Combustion Industries, Inc., Dept. HPAC, Times Bldg., New York.*

"Compact" boilers are built in 11 sizes, from 20 to 200 bhp. Unit consists of burner, controls, refractory, insulation and draft equipment, installed, wired at factory. Basic boiler is of horizontal, four pass, downdraft type. Units guaranteed to give minimum of 80 percent thermal efficiency over entire firing range, with stack temperatures not exceeding 125 F above steam or water temperature.



Two Volume Fan . . .

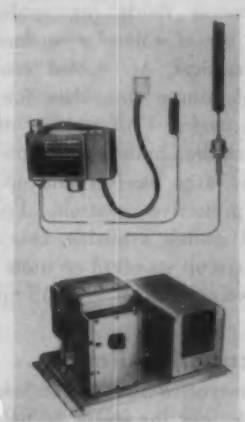
. . .without pulley changes or other mechanical manipulations — *Morrison Products, Inc., Dept. HPAC,* 16816 *Waterloo Rd., Cleveland* 10.

When regular room thermostat indicates heating is required, "Du-Air" centrifugal fan shifts to correct air delivery for heating, says manufacturer. Automatic damper control mechanism is 1½ in. wide, attached to fan housing. Adaptable to present systems, works from regular room thermostat by switch or automatically.

Cooling Tower . . .

. . .with no moving parts (fans, motors, pulleys, etc.), constructed of glass fiber—*Koch Engineering Co., Inc., Dept. HPAC,* 321 *W. Douglas, Wichita, Kans.*

Glass fiber of one piece molded construction is incorporated into "Jet" cooling tower. Tower resists heat, cold, will not show hail damage, says manufacturer; one man can lift 7½ ton capacity tower. Air movement, cooling accomplished by system of water jet nozzles at top of tower. Nozzles spray downward, cause movement of volume of air through tower, also atomize water into particles, causing mixture of air and water for cooling. Tower is available in 3, 5, 7½, 10, 15, 20, 25 nominal tons.



Control Package . . .

. . .for electric heating type of unit ventilators—*Barber-Colman Co., Dept. HPAC,* 1300 *Rock St., Rockford, Ill.*

Package unit consists of dual element thermostat which provides control of room and discharge air, electric motor operator to position heater control switches, outdoor and return air dampers to provide unit ventilator control cycle Y, step controller for control of heaters. Package is completely prewired. Recommended for classroom use.

Submersible Motors . . .

. . .designed for direct coupling to pumps operating continuously while submerged in oil, water, liquid chemicals—*Reliance Electric and Engineering Co., Dept. HPAC,* 24701 *Euclid Ave., Cleveland* 17.

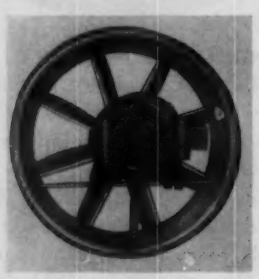
Polyphase, a-c, single voltage submersible motors are available in sizes ¾ through 15 hp. Have universal mountings for direct connection to most standard pumps, says manufacturer, but modifications can be made to meet special dimensional requirements. Rated at 55 C temperature rise for 30 min duty in 40 C air and for continuous duty in 40 C liquid; motors are oil filled. Neoprene diaphragm in motor base flexes slightly to offset differences between internal, external pressures, relieving pressure buildup around positive shaft seal or o-ring seal between motor frame and mounting bracket.

Environmental Chambers

. . .designed to facilitate controlled temperature environmental testing with vibration machines—*Tenney Engineering, Inc., Dept. HPAC,* 1090 *Springfield Rd., Union, N. J.*

Model "27TDIV-100600" is per-

manently mounted on fork lift. Unit has work space of 3 × 3 × 3 ft, removable bottom, side panel to accommodate horizontally or vertically positioned vibration heads, also has full opening door with viewing window, interior lighting. Interior is of type 300 stainless steel, exterior of primed, enameled stainless steel. Temperature range is −100 to 600 F; recording and controlling instrumentation tolerances ± 2 deg.



Orifice Ring Fan . . .

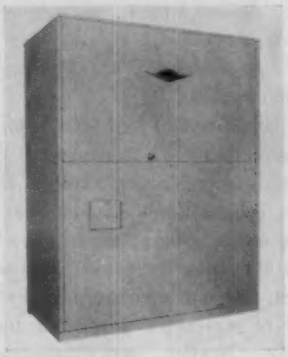
. . .designed for industrial ventilation, drying, smoke and fume removal, utilizes aerodynamic blade design—*Chicago Blower Corp., Dept. HPAC,* 9863 *Pacific Ave., Franklin Park, Ill.*

Airfoil design of type "DC" produces high pressure characteristic. Hub designed in equal proportion to wheel surface. Constructed of aluminum or steel, all blades hollow, dieformed in one piece welded unit. Each of 14 models, from 12 to 72 in., available with 2, 4, 6, and 8 blades. Standard motors operate in temperatures to 120 F, glass insulated models to 180 F. All units designed for horizontal or vertical installations.

Air Compressors . . .

. . .with single stage centrifugal compressor in barrel type casing—*Allis-Chalmers Mfg. Co., Dept. HPAC, Milwaukee* 1.

New unit can operate at working pressure up to 500 psia. Casing features cited: cylinder casing; bolted casing head and fabricated bearing pedestal. Other design features: welded impeller; sleeve type load bearings with removable liners; chemically bonded with tin base babbitt; Kingsbury-pivoted shoe thrust bearing; statically and dynamically balanced rotating assembly. Recommended by manufacturer for work in petroleum, chemical industries and for recirculating high pressure gas for cooling, processing.



Liquid Chillers . . .

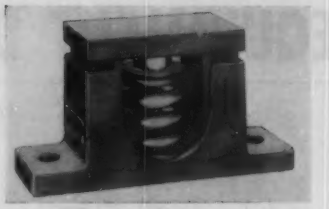
. . .of 3 to 15 hp rating, installed by hooking water and electrical connections—*American Coils Co., Dept. HPAC, Route* 524, *Lakewood Rd., Farmingdale, N. J.*

"ACI-AA" packaged chiller units are designed to provide chilled water or process fluids for applications where use of water for condensing is not practical. Air cooled condenser has aluminum fin tubes for rapid heat transfer. Unit consists of insulated chiller, built-in air cooled condenser, large receiver and operating and protective controls. Five air cooled models available. One refrigerant circuit standard on units to 7½ hp; two circuits on 10 to 15 hp units.

Packaged Boiler . . .

. . .constructed in high or low pressure designs for steam or hot water service—*Orr & Sembower, Inc., Dept. HPAC, Box* 1138, *Reading, Pa.*

"Model 5 Powermaster" is equipped with mechanical pressure atomizing oil burner or partial premixing gas burners for burning light oil or gas fuel. Combination burners for burning either oil or gas can be furnished. Unit is produced in 15, 20, and 30 hp sizes. Electronic programming and safety controls provided. Accessory controls and equipment also available to adapt unit to specific applications.



Vibration Isolation . . .

. . .designed to simplify machinery installations, protect against vibration, shock—*Korfund Co., Inc., Dept. HPAC,* 48-01 *F* 32*nd Pl., Long Island City* 1, *N. Y.*

"Type LO" mounting, utilizing steel springs as cushioning medium, available for load capacities 150 to 23,000 lb. Housings are cast semisteel, with access port on each side. Mount has smooth flat top, permitting unit to be placed in any position under machine base, according to manufacturer. Tapped holes can be furnished in top of plate for bolting equipment to mount. Recommended for applications with fans, cooling towers, motor generator sets, furnaces, pipe supports, turbines, packaged air conditioning, air handling units.

Cooling Towers . . .

. . .designed to occupy minimum floor space—*Mason Products, Inc., Dept. HPAC,* 317 *A Main St., West Concord, Mass.*

New line of induced-draft water cooling towers, designated "Hydra-Glide", are available in capacities 8 to 75 tons. "Model 3108," with 8 ton capacity occupies 10.2 sq ft of floor space; 75 ton "Model 3175" requires 47 sq ft. Towers preassembled at factory; tower's slip-fit joints casing to simplify disassembly. All cas-

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EQUIPMENT DEVELOPMENTS

Continued

ings fabricated of fully reinforced, heavy gage steel, says manufacturer. Features cited: plastic coating; venturi type fan throat; drift eliminators; stainless steel fan shaft; over flow and drain fittings; one grease point; open type distribution box; location of motor above fan, out of humid air stream.

Temperature Relief Valves

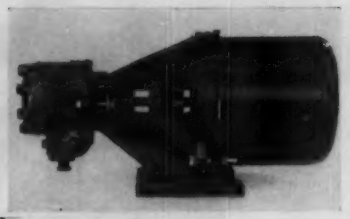
...developed to provide temperature protection for hot water tanks, heaters —*A. W. Cash Valve Mfg. Corp., Dept. HPAC,* 6621 *E. Wabash Ave., Decatur, Ill.*

"Type TR" valves constructed of bronze castings with brass internal parts, silicone seat disc, positive acting thermostat which opens valve at 210 F, closes at 180 F. Maximum pressure is 150 psi. Available in 11 models.

Air Duct Sealer . . .

...with synthetic rubber (butyl) base—*Goodloe E. Moore, Inc., Dept. HPAC, Danville, Ill.*

"Tuff-Bond No. 12" spreads in two or three min, dries overnight. Adhesion to galvanized iron is strong, according to manufacturer. Thermal limits are −30 to 200 F. It is said to have high resistance to gasoline, oil, water, alipathic hydrocarbons. Tan in color, with viscosity of heavy syrup; weighs approximately 9 lb per gal, has average container stability of six months.



Boost Pump . . .

...developed to supply fuel oil to overhead heaters, furnaces—*Sundstrand Hydraulic Div., Dept. HPAC,* 2210 *Harrison Ave., Rockford, Ill.*

Single or two stage pump assemblies are available, with or without motor. "Model BJ-100-M" includes single stage pump; "Model BH-100-M" includes two stage pump (when designated without motor, drop "M" suffix). Delivery rate of boost pump is 30 gph with No. 2 feed oil. Pump is driven by standard 2 lug NEMA "N" flange oil burner motor at 1/8 hp, 115 volt, 60 cycle, 1725 rpm.

Temperature Regulators

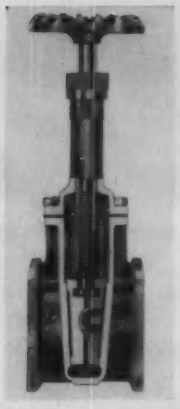
...with changes intended to improve control, eliminate leaking stuffing boxes, simplify changes in valves—*Fllton Sylphon Div., Robertshaw-Fulton Controls Co., Dept. HPAC, Box* 400, *Knoxville* 1, *Tenn.*

Company's line of temperature regulators has plastic "chevron" stem packing as standard equipment. Packing is self-lubricating, facilitates valve exchange.

Sleeve Bearing Motors . . .

...in sizes 3/4 through 15 hp—*Reliance Electric and Engineering Co., Dept. HPAC,* 24701 *Euclid Ave., Cleveland* 17.

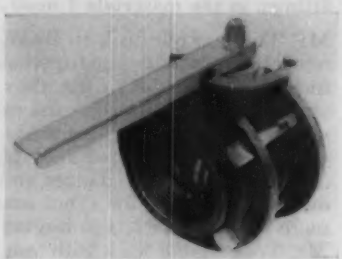
Polyphase, a-c motors available in all standard enclosures 208 through 550 volts. Motors have cast iron outer construction for protection against corrosive elements. Insulation system protects coil heads, connections. Rotor is dynamically balanced.



Gate Valve . . .

...with aluminum body, nylon seat discs—*Jordan Industrial Sales Div. of OPW Corp., Dept. HPAC,* 6013 *Wiehe Rd., Cincinnati* 13.

Weight of "No. 76" gate valve with aluminum body and nylon seating discs is 40 percent that of conventional gate valve, according to manufacturer. Absence of dissimilar metals gives guard against possibility of electrolytic corrosion. Seat rings unnecessary. Available in 3 in. screwed end size; other sizes to be available.



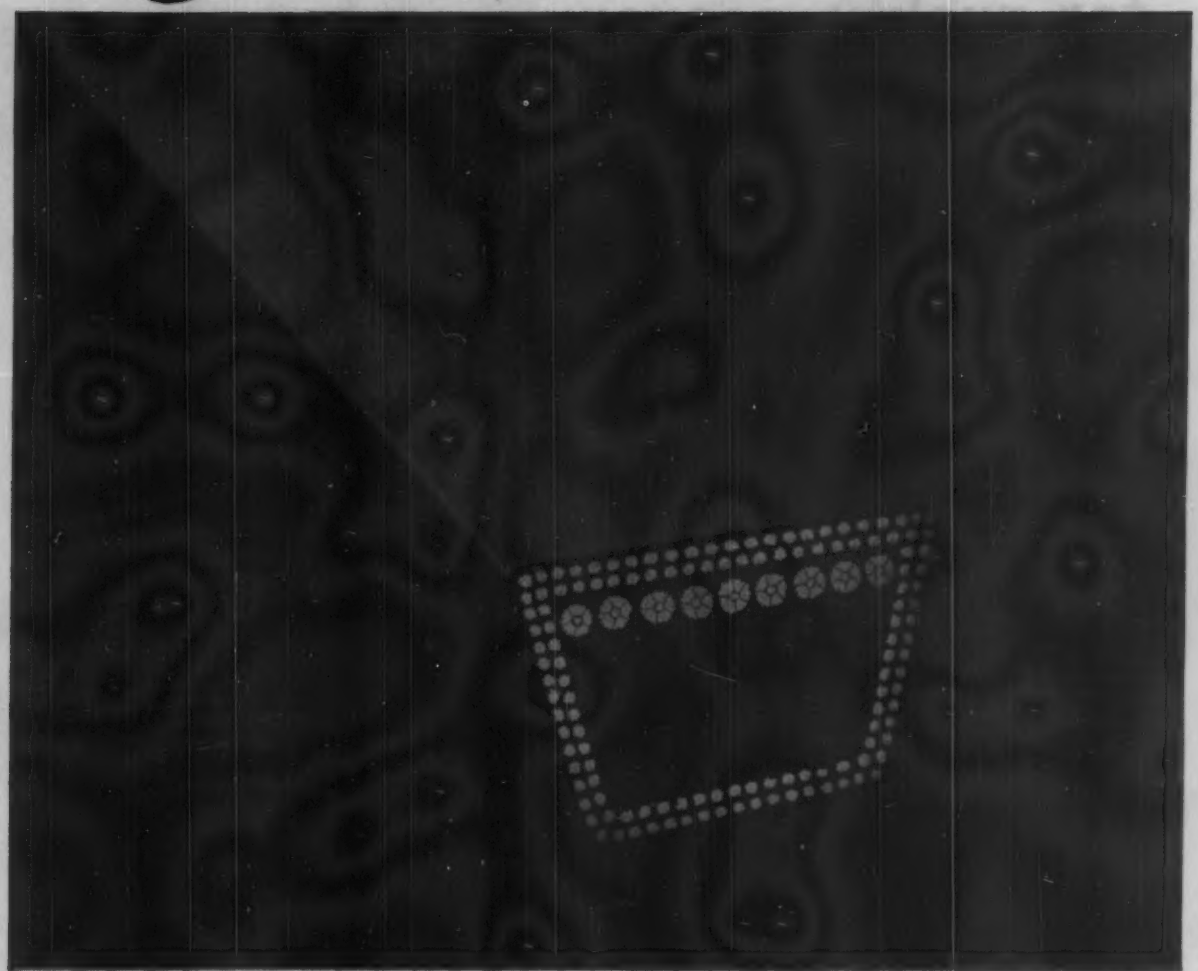
Valve Control . . .

...developed to hold butterfly valves under extreme pressure at an infinite number of settings — *Reid Metal Products, Inc., Dept. HPAC,* 2021 *N. Lincoln St., Burbank, Calif.*

According to manufacturer, device can withstand up to 1000 in.-lb torque with less than 1.160 deg deflection in 4 in. valve. Irreversibility is said to be provided by action using pins (shear) held in shoes to create a reaction on a quadrant. As pressure is applied in one direction, one pin in each shoe is slightly rotated, brought to bear on quadrant, giving locking action. As reverse pressure is applied, alternate pins contact.

(*Continued on page* 189)

US RUBBER UNITENSION V-BELTS



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"SPANG galvanized steel pipe is tops for quality, economy and service"

says Mr. W. Edwin Cothran, Vice President, J. H. Cothran Co., Inc., Altavista, Virginia

"We turned to SPANG for our pipe requirements, because they could meet our deadline for top-grade pipe where others could not," reports Mr. Cothran.

"The $400,000 plumbing, heating and air conditioning contract for the Facquier Hospital, Warrenton, Va., was a big order, and any delay in delivery would have resulted in large unproductive time costs. In addition, these 'plus' advantages with SPANG Pipe:

"By using SPANG Galvanized Steel Pipe instead of other kinds of pipe for the drain conductors, we saved about 25% fabricating time.

"For the vacuum lines, SPANG Galvanized Pipe is ideal: it withstands more air pressure and is more economical than other kinds of piping.

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Architect: Ballou & Justice, Richmond, Va.
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SPANG Steel Pipe is used throughout the Facquier Hospital for drain conductors, vacuum lines and steam lines. SPANG Pipe saved installation time, helped cut construction costs.

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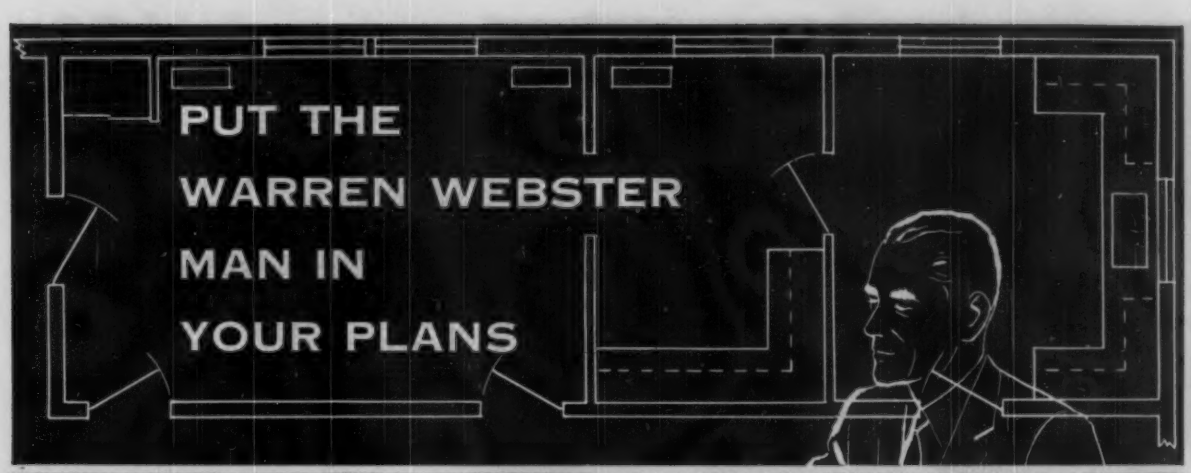

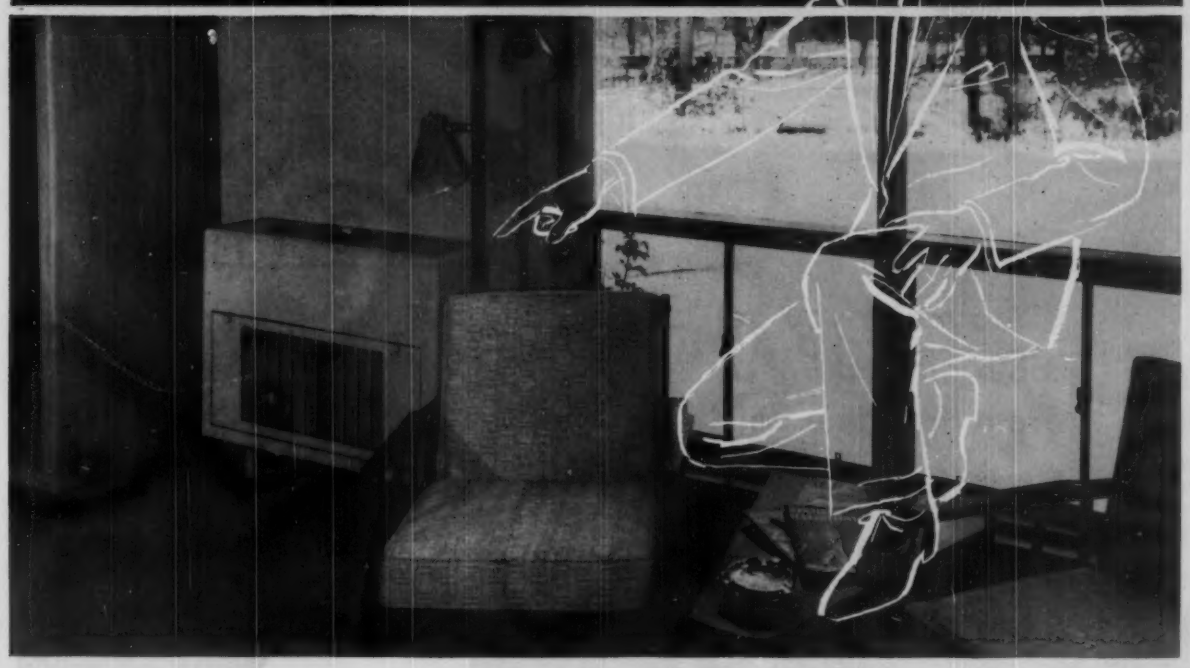

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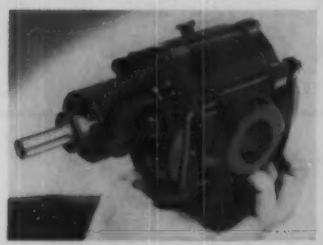
EQUIPMENT DEVELOPMENTS

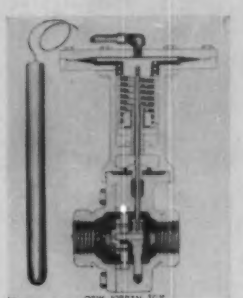
Continued from page 184



Gear Pump . . .

. . . designed to handle acids, alkalies to 12 gpm — *American Hard Rubber Co., Div. of Amerace Corp., Dept. HPAC, Ace Rd., Butler, N. J.*

"Ace GKF" gear pump has all hard rubber casing and gears, rubber covered shaft. Typical applications: handling acids from carboys and tanks, pumping from tank to process, pumping on acid tower work, direct agitation of plating or other solutions. Equipped with standard ½ hp, 875 rpm motor, pump delivers approximately 12 gpm maximum. Maximum head is 120 ft (52 psi). Motor is totally enclosed, drive is direct. Suction and discharge tapped for 1 in. standard pipe.



Control Valves . . .

. . . with plastic coated sensing bulb— *Jordan Industrial Sales, Div. of OPW Corp., Dept. HPAC,* 6013 *Wiehe Rd., Cincinnati* 13.

Plastic coated sensing bulb and thermal system now available with company's "Sliding Gate" control valves. Intended for use in plating tanks, chemical tanks or heaters, other corrosive applications. Plastic coating gives resistance to variety of chemicals. Suitable for temperatures to 185 F. Capillary tubing available in 8 and 15 ft and special lengths. Available in sizes ¼ through 2 in.

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Power Line

best solves your industrial ventilation problems:

1. Complete line: Broadest product line of air-moving equipment for every industrial requirement.

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YOURS ON REQUEST: Big 20-page Power Line Catalog gives complete facts about industrial ventilation, including selection of proper type and size of fan, calculation of duct resistance, and installation procedures, plus features, dimensions, specifications and performance data. Without obligation write for your free copy of Catalog No. 97B.

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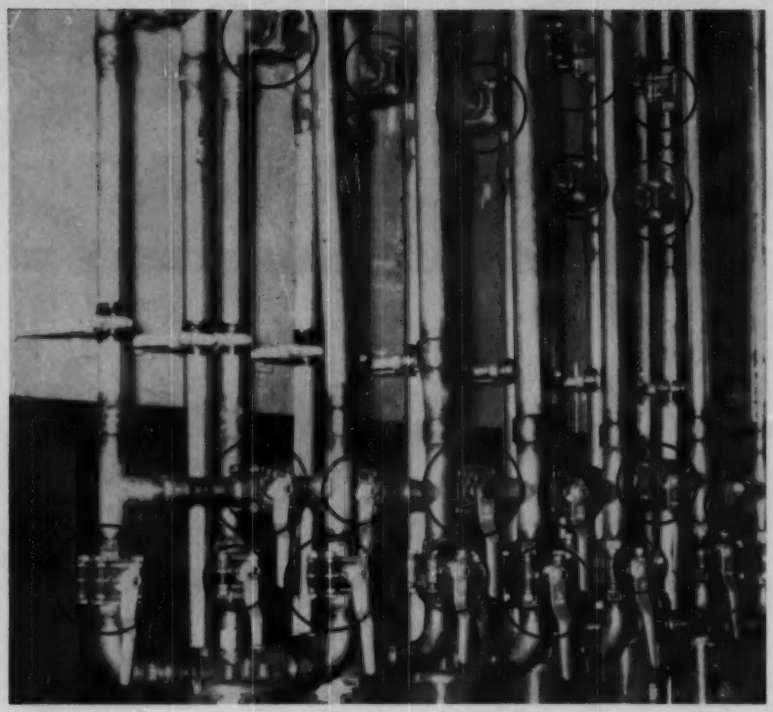
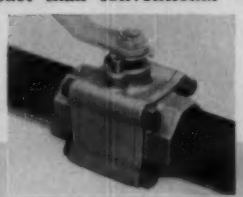


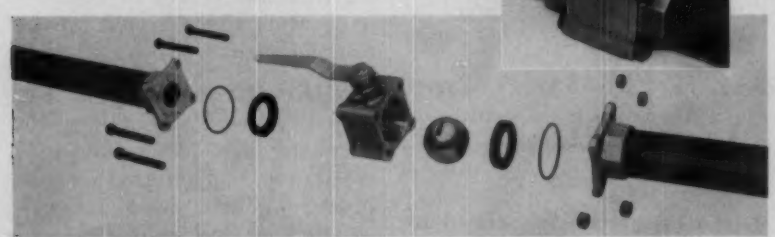
Only the ECON-O-"MISER" Ball Valve was able to solve this problem for PathéColor, Inc.

THE PROBLEM: To find a valve that would meet all of the following requirements:

1. Quick visual indication of position and quarter turn operation. 2. Excellent flow characteristics and positive shut-off. 3. The advantages of flange construction without the bulk and weight of conventional flanged valves. 4. Easy & quick disassembling for low cost maintenance. 5. The most compact and economical installation of Type 316 stainless steel valves possible.

SOLUTION: *Specifying* and *installing* Worcester's Econ-o-"miser" Ball Valve. In so doing PathéColor found a valve that provides a positive seal, a flanged construction much more compact than conventional valves that could be socket welded. In addition many unions and companion flanges were eliminated with the overall result that savings on this installation alone amounted to many hundreds of dollars.





Valves available, ¼"-2", in following standard materials*: Bronze, Aluminum Bronze, Aluminum, Carbon Steel and Types 303 and 316 Stainless Steel. Standard Seat and O-Ring materials*: Buna-N, Neoprene, and Teflon.

**Other materials available on request.*

For further information and descriptive literature write to:

WORCESTER VALVE CO., INC.

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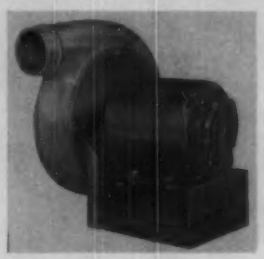
EQUIPMENT DEVELOPMENTS

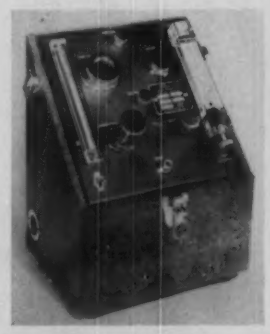
Continued



Centrifugal Fans . . .

. . .designed specifically for severe duty applications in milk packaging industry—*American Blower, Div. of American-Standard, Dept. HPAC, Detroit* 32.

Both models are direct-drive designs. Blower wheel and housing are cast aluminum. "Model 89B95" has a ½ hp totally enclosed induction motor, operating at 3450/2875 rpm. Blower capacity is 590 cfm free delivery and 220 cfm at 6 in. WG static pressure. "Model 89B108" has 1/12 hp totally enclosed split phase motor, operating at 3450 rpm. Blower delivers 175 cfm at 1 in. WG and 50 cfm at 3.3 in. WG static pressure.

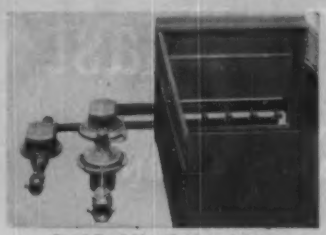


Dew Point Indicator . . .

. . .designed for measuring gases under pressure—*Illinois Testing Laboratories, Inc., Dept. HPAC,* 420 *N. La Salle St., Chicago* 10.

When gas source is under pressure, use of "7200" avoids necessity for hand pumping, purging and adjustment of pressure ratio, says manufacturer. Instrument incorporates bypass valve, rupture discs as safety devices to protect instrument. Recommended by company for applications on gas pipe lines, compressed air lines, instrument air lines, bottled gas, etc.

HERE ARE THE *EXTRA VALUES* YOU'VE WANTED IN A COMMERCIAL GAS BOILER



Dual Fuel Manifold and Base

Dual Fuel Control

DUAL FUEL MANIFOLD—optional

This optional feature permits the "J" Boiler to operate on natural gas during normal load periods and change over to LP Gas for low temperature peak loads. Both gases are properly burned within the same combustion zone.

PRE-WIRED ELECTRONIC CONTROL PANEL—optional

The Weil-McLain Model "CP" is a complete gas boiler control system built into a compact panel, factory-assembled and tested. The panel reduces electrical work to a minimum—assures lower installation cost as well as correct operation of the boiler and its electronic safeguard controls.

*Hydronics—the science of heating and cooling with water.

To schools, apartments, commercial and industrial buildings, the Weil-McLain Type "J" Gas Boiler offers dependable hydronic* heating at low operating cost. It is designed in every detail to burn fuel efficiently and to absorb a maximum amount of heat.

Cast iron construction assures long life, with minimum repairs. The "J" Boiler is easy to maintain at top efficiency... simply pulling out the clean-out plates makes the spaces between the sections accessible for cleaning.

The compact design of this boiler permits installation in a small boiler room—saves in construction cost. It's faster to erect because short draw rods simplify installation—assure a strain-free assembly.

The Weil-McLain Type "J" Boiler, in capacities from 625,000 to 5,000,000 A.G.A. input BTU/hr., burns all gases automatically and safely.

Send for engineering data

WEIL-McLAIN

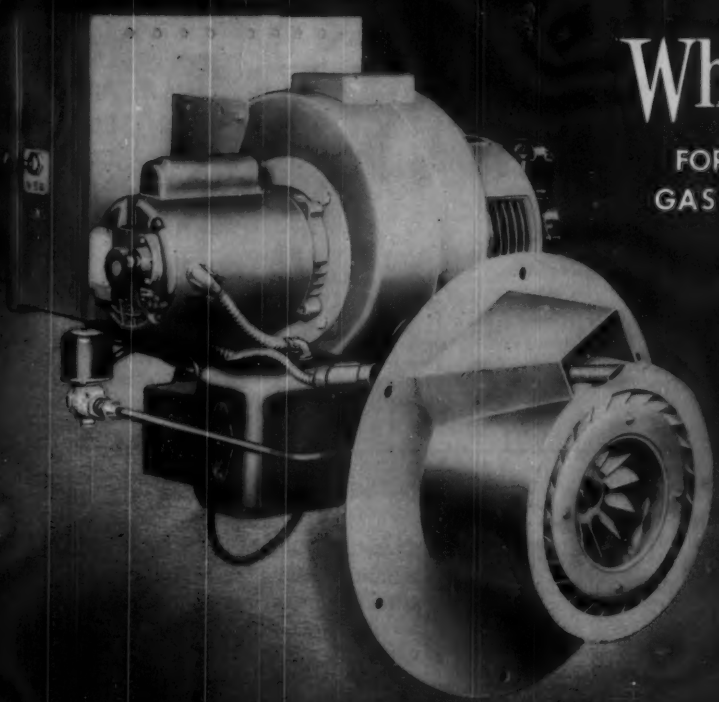
TYPE J GAS-FIRED BOILER

WEIL-McLAIN BOILERS · RADIATORS

WEIL-McLAIN COMPANY
MICHIGAN CITY, INDIANA

Address literature requests to Dept. AA-68.

Another new development by Iron Fireman



WhirlBlast

FORCED DRAFT
GAS-OIL BURNER

Now...forced draft firing for smaller boilers

The Iron Fireman WhirlBlast gas-oil burner was created to fill the need for forced draft firing in all types of medium size boilers and particularly for the increasingly popular sealed firebox Scotch boiler. Now you can have the advantages of forced draft firing in boilers as small as 18 bhp. The necessity for costly and unsightly smokestacks has been eliminated. All air for combustion is supplied by the burner blower. No extra motors, fans or draft ports are required.

No pulsation

A newly developed firing head has solved the old problem of flame pulsation. This has been accomplished without recourse to firebox vents or other alterations.

Outstanding features of the WhirlBlast burner

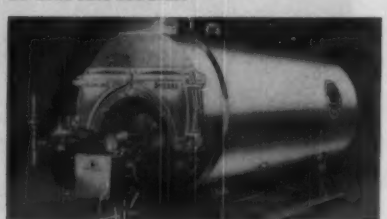
1. **Switches fuels instantly.** Fuels can be changed automatically with appropriate controls, or manually by the flick of a switch.

2. **No high smokestack.** A stub stack or vent is all that is required.

3. **For all types of boilers.** Fires sealed firebox boilers under pressure. Also greatly improves draft conditions in natural draft boilers.

4. **Easily installed.** Available with either a flange or pedestal mount. Bolts directly to the boiler front. Inverted model (with draft tube on top) permits mounting on Scotch boilers without interfering with flue doors.

5. **Fuels.** Fires No. 2 fuel oil and all types of fuel gas. Available in either oil, gas or dual fuel models.



Complete package ready to operate — boiler, burner, controls

Complete boiler-burner units assembled, wired and tested at the factory. Totally enclosed control panel is built into the burner. Wide range of sizes; easily specified by model number.

IRON FIREMAN®

AUTOMATIC FIRING EQUIPMENT
FOR HEATING, PROCESSING, POWER

For more information, mail coupon

IRON FIREMAN MANUFACTURING COMPANY
3083 West 106th Street, Cleveland 11, Ohio.
(In Canada, 80 Ward Street, Toronto, Ontario)

Please send more information and specifications on the Iron Fireman WhirlBlast burner.

Name_____

Firm_____

Address_____

City_____ Zone____ State_____

EQUIPMENT DEVELOPMENTS

Continued

PVC Sheets . . .

. . . developed for fabrication of PVC tanks, ducts, other fabrications—*Colonial Plastics Mfg. Co., Dept. HPAC, 2685 E. 79th St., Cleveland 4.*

Joining strips are designed to replace hot air welding of PVC stock. Two shapes of joining strip available: 90 deg strips for making corners; H strips for use in single plane, can be used with sheet 1/8, 3/16, 1/4 in. gages. Standard strip length is 10 ft. For flanges, stiffeners of fabricated sections, extruded structural angles in 10 ft lengths available in sizes 1½ × 1½ × 3/16 in. and 2 × 2 × ¼ in.

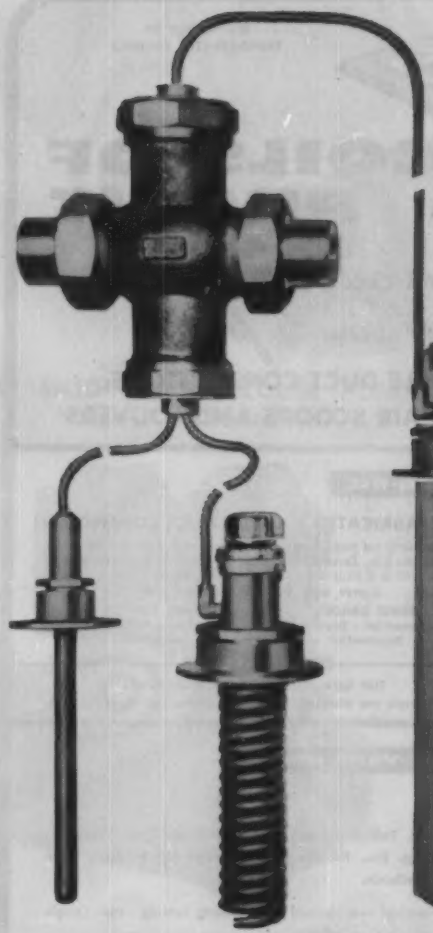
Expansion Valves . . .

. . . with two new engineering features—*Alco Valve Co., Dept. HPAC, 865 Kingsland Ave., St. Louis 5.*

New design for power assembly of "Thermo" expansion valves limits amount of flexing of diaphragm. New remote bulb and well design gives more rapid response to temperature changes in line, providing quick closing for protection against liquid "flood back" and control for optimum system performance.

Unit Heater . . .

. . . with design change intended to reduce cost, weight, improve safety — *L. J. Wing Mfg. Co., Dept. HPAC, 140 Vreeland St., Linden, N. J.*



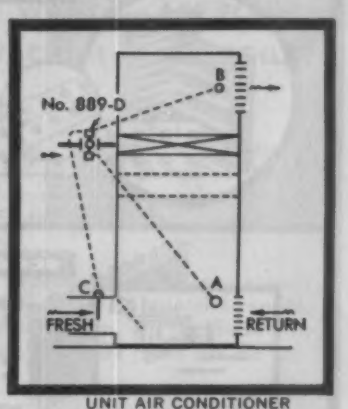
Is this a
COST-SAVING IDEA
for you?

Now... modulating control of steam heating in commercial air conditioning systems!

Low-cost Sylphon® No. 889 Regulators are being successfully used as heating controls on "packaged" air conditioners for small shops, restaurants, stores and other commercial buildings.

These same self-operated controls are suitable for central systems. Both room temperature control and "weather-compensated" control of low limit (discharge) temperature are included in one regulator unit.

Initial cost is lower than for pneumatic and electric types designed to do this job. Installation is simple and inexpensive—no tubing or wiring to run. Available with adjustable thermostatic bulbs or wall thermostats. Control knobs are concealed inside cabinet for modern, clean look.



UNIT AIR CONDITIONER

Write for Catalog E-LH

Mr. Controls

Robertshaw-Fulton
CONTROLS COMPANY

FULTON SYLPHON DIVISION • Knoxville 1, Tenn.

ALL SHIPPED IN DISPENSER-TYPE CARTONS

CAINS

COILS OF PROFIT

Quick, Economical, Easy, and Practical Methods for---

FABRICATING FLEXIBLE DUCT CONNECTIONS
VANES FOR ELBOWS • AIR SCOOPS AND LOUVERS

PRE-FAB-RIC

A PREFABRICATED FLEXIBLE DUCT CONNECTION

Using a fabric (of your choice) in the center with a galvanized metal strip on each side. *Double-Safe Locked* together in a single continuous piece, coiled in a dispenser-type carton ready for use.

A TYPE, SIZE, AND PRICE FOR ALL JOBS

THREE GRADES
Commercial - Economy
Residential

THREE FABRICS
Canvas - Asbestos
Neoprene

FAB-RIC

TOP QUALITY FABRICS (Without Metal)
Same Weight and Width (8") Used in PRE-FAB-RIC. Put Up in 100' Rolls

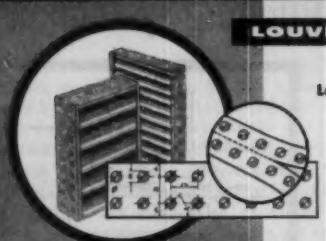
INSTANT-VANE RAIL

ELIMINATES

Layout, Tab Cutting, Hole Punching, Spot Welding, Riveting, Etc., Results in a Savings Up to 70% over old methods.

Best method ever devised for installing turning vanes (single or double) in sq. elbows.

100 FT. COILS ENGINEER APPROVED



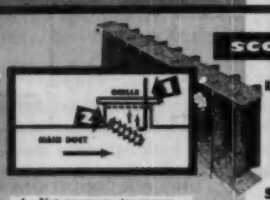
LOUVERAIL

ELIMINATES

Layout, Tab Cutting, Hole Punching, Riveting, Spot Welding, Etc.

AN ECONOMICAL AND PRACTICAL METHOD FOR FABRICATING LOUVERS — REMOVABLE, HINGED, OR STATIONARY. LOUVERAIL is 24 ga. galvanized 4½" wide in (2—50' lengths) 1 right and 1 left coiled together.

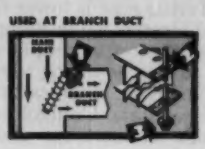
Split (½) Rail for Louver Thicknesses From 1¼" to 1¾". Use Full Size Rail for Louver Thicknesses From 3¼" to 4".



SCOOP-RAIL

ELIMINATES—
- Radius ell, transition, and splitter damper at branch duct take-offs.
- Volume damper on grille.
- Job delay in ordering.

USED AT BRANCH DUCT



1. Not necessary to remove grille to adjust volume. Use brass rod or wire thru grille to adjust unit in and out of main duct.
2. S. M. screws at top and bottom.

SCOOP-RAIL for fabricating air scoops for branch ducts and grille collars. Insuring uniform air distribution. Complete control of air volume in branch duct or at grille face. Simplifies balancing of the system.

1. ¾" standard quadrant where accessible.
2. Speed nut tabs for ¾" square rod are riveted, spotwelded or s. m. screwed to ends of SCOOP-RAIL.
3. Where desired clg. control may be used.

SOLD ONLY THROUGH JOBBERS AND DISTRIBUTORS Union Made
Some Territories Open for Manufacturers Agents Calling on Jobbers and Distributors

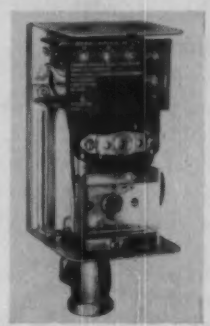
CAIN MANUFACTURING CO.

1111 North 35th Avenue Phone FA 2-0334 Birmingham, Alabama

EQUIPMENT DEVELOPMENTS

Continued

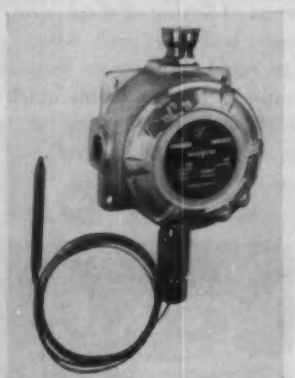
Motor mount on revolving air heaters have been changed from welded steel tubing to wire screen. New design is said to prevent personal injury during maintenance.



Motorized Control Valves

...intended for hot water systems — *Edwards Engineering Corp., Dept. HPAC,* 101 *Alexander Ave., Pompton Plains, N. J.*

Valves, ¾ and 1 in., use motor drive said to be 75 times more powerful than clock motor. No electrical current is drawn to hold valves after they are opened or closed upon signal from controlling thermostat, which also turns on burner and pump on heating unit.



Temperature Control . . .

...with explosionproof feature— *United Electric Controls Co., Dept. HPAC,* 79 *School St., Watertown* 72.

Dual switch "Type D98A" is a sensitive, remote bulb temperature designed for use in hazardous locations where explosive vapors, gases present. Two switches permit switch action above, below set point, control

Skidmore

There's a Skidmore Pump designed for each and every heating requirement. *Write for bulletins*

THE SKIDMORE VACUUM PUMP

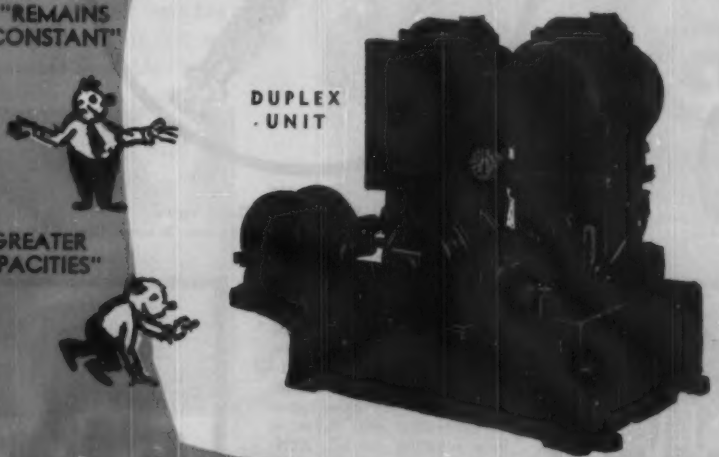
"Maintained Efficiency"

"REMAINS CONSTANT"

"GREATER CAPACITIES"

DUPLEX UNIT

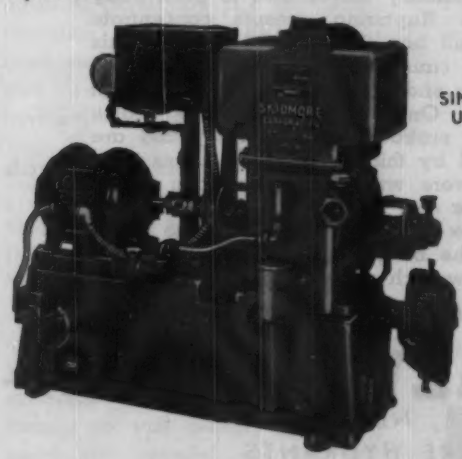
"LOW RETURN"



MAINTAINED SKIDMORE PUMPS EFFICIENCY

GREATER EFFICIENCY AND CAPACITY

Both the single and duplex unit automatically adjusts itself to the varying conditions of the system. Capacities ranging from 5,000 to 100,000 sq. ft. EDR.



SINGLE UNIT

ALL THE FEATURES YOU WANT — **ARE FOUND IN THE SKIDMORE VACUUM AND BOILER FEED PUMPS**

Perfect balance, structural simplicity and greater increase in efficiency is attained as compared to other pumps of the hydraulic type. Liberal clearance between moving parts positively eliminates wear. That is why all Skidmore Vacuum Pumps are famous for—"Maintained Efficiency".

Because wear is eliminated, the capacity and efficiency remain constant year after year without adjustment or expensive repairs. When you choose a Skidmore Vacuum Pump, you can do so with confidence, knowing that ten years from now it will still be performing its full duty satisfactorily.

Write today for descriptive bulletin

SKIDMORE PUMPS

SKIDMORE CORPORATION

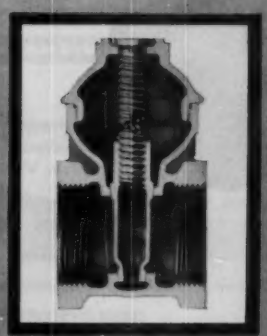
ST. JOSEPH, MICHIGAN

Here's How KENNEDY'S Kenalloy Stem and Union Bonnet Are Made for Better Service... Easier Operation...

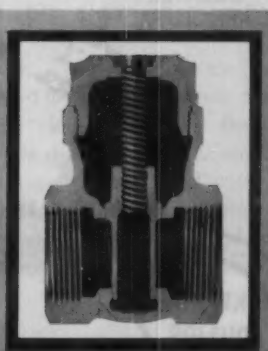
Fig. 525

Fig. 525
125-Pound SWP Bronze Gate Valve
Union Bonnet - Rising Stem - Inside Screw - Wedge Disc

In bronze body valves, stems made of ordinary metals are subject to a form of corrosion known as dezincification. Many fluids attack such stems in such a way as to cause the zinc to be entirely removed from the alloy. This sort of corrosion leaves the stem in a porous, very weak condition and it soon breaks in service.



Kennedy bronze body valve stems are made from a specially developed metal called KENALLOY. This alloy is powerfully inhibited against dezincification, as well as many other types of corrosion, and it is a long wearing metal. KENALLOY produces beautiful, non-galling smooth threads and bearing surfaces to make the valve easier to operate and it assures far longer life in the "heart" of the valve.



These additional advantages make KENNEDY your best valve buy...

Kennedy's Union Bonnet permits repeated dismantling for cleaning or inspection and reassembly without danger of distortion of the valve. The bronze-to-bronze construction makes a tight union for tight, leakproof operation.

Heavy bronze union bonnet ring is entirely separate from the bonnet to eliminate any possibility of springing the bonnet joint face when assembling or disassembling the valve.

The cylindrical body withstands sudden pressure. Kennedy's Cylindrical Body construction resists rupture and minimizes deflection when under severe pressure. Pressure in ordinary valves tries to push body wall out. Rupturing stresses concentrate where wall has the shortest radius. This deflection causes early valve failure.

Wider hex ends, blended into body, prevent distortion. On conventional valve bodies hex ends protrude from the body and are connected by thin body wrists. This area under severe wrench pressure can distort and cause disc seating trouble. Kennedy's wider hex ends are blended into body making the body and hexes one unit. In this way wrench pressures can be absorbed.

• *YOU CAN'T BUY A BETTER VALVE THEN A KENNEDY!*

KENNEDY VALVE MFG. CO.

1607 EAST WATER ST., ELMIRA, NEW YORK

VALVES • PIPE FITTINGS • FIRE HYDRANTS

• OFFICES AND WAREHOUSES IN NEW YORK, CHICAGO, SEATTLE, SAN FRANCISCO, ATLANTA • SALES REPRESENTATIVES IN PRINCIPAL CITIES •

EQUIPMENT DEVELOPMENTS

Continued

of independent circuits. Temperature settings made by rotating calibrated knob over graduated barrel. Individual adjustment of switches accomplished by hex-head screws, providing 15 deg span; other spans available. Standard head compensation provided, effective from −65 to 160 F. Unit has cast iron base, cast aluminum cover. Three standard types of switches available: normally open, normally closed, double-throw with no neutral position. Switches rated for 15 amp at 115 or 230 volts a-c. Other switches available.

Insulation Jacket . . .

. . . designed to enable limited number of units to cover most sizes of insulated piping—*Pittsburgh Corning Corp., Dept. HPAC, One Gateway Center, Pittsburgh* 22.

"Gasco Humped Aluminum" elbow is oversize radius that allows use over several pipe, insulation sizes and on long, short ells. Twelve interchangeable sizes of ells fit over 107 combinations of varying pipe sizes and insulation thicknesses. Humped elbows made of heavier gage aluminum than standard jacketing elbows; have no metal folds.

Baseboard Heating Panels

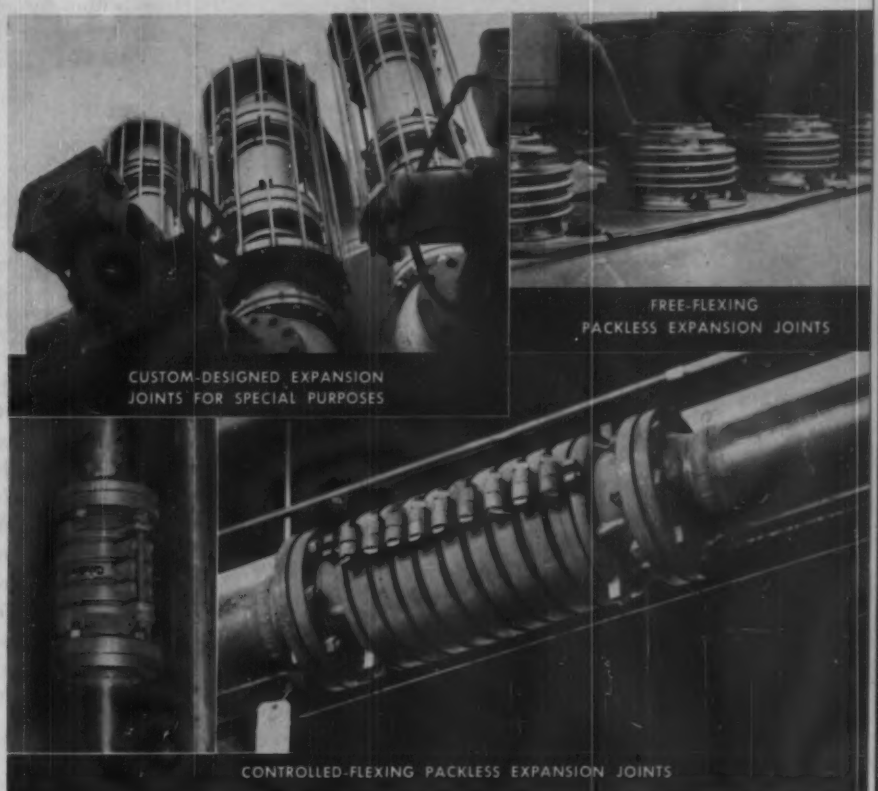
. . . with new accessories—*American-Standard Plumbing and Heating Div., Dept. HPAC,* 40 *W.* 40*th St., New York* 18.

Among new accessories for "Radiantrim" baseboard heating panels are: screw-on end boxes, corner and valve enclosures, removable without damage to wall plaster; extension panel with rounded apertures to match cast iron heating panels.

The answer to your pipe expansion problems

Flexon

Expansion Joints


CUSTOM-DESIGNED EXPANSION JOINTS FOR SPECIAL PURPOSES
FREE-FLEXING PACKLESS EXPANSION JOINTS
CONTROLLED-FLEXING PACKLESS EXPANSION JOINTS

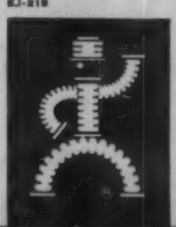
Here's where you'll find the skill and experience to guide your selection of ways to take care of pipe motion problems. Flexon engineering gives you more – more research, more metallurgical care, more service, more "standards" to select from. And all of these add up to expansion joints that you can *install and forget!* Free-flexing and controlled-flexing; pressure-balanced joints and other special designs; all in stainless steel, monel, and other workable alloys.

Member of Expansion Joint Manufacturers Association

Why settle for *less* – when experience shows that you get *more* of everything from Flexon?

TODAY — write for your copy of this 28-page Flexon Expansion Joint Design Guide

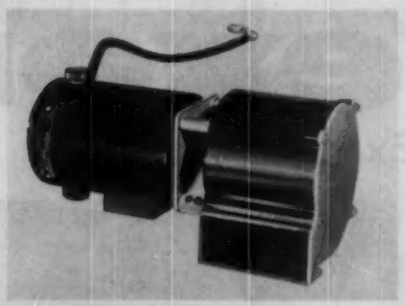
EJ-218



Flexonics corporation

EXPANSION JOINT DIVISION • 1391 S. THIRD AVENUE, MAYWOOD, ILLINOIS

EQUIPMENT DEVELOPMENTS — *Continued*



Compact Centrifugal Fans . . .

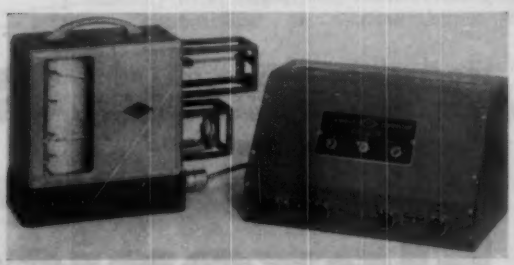
. . . for military and commercial electronic equipment cooling—*American Blower, Div. of American-Standard, Dept. HPAC, Detroit* 32.

New units available in variety of sizes and arrangements intended for electronic cooling applications where compactness, blower efficiency are important. Several models specifically designed for cooling military or commercial electronic equipment, radio and TV transmitters, radar, communications sets, large electric motors. Available with single or double inlets, single or double wheels, direct or v-belt drive and offset or direct discharge.

Totally-Enclosed D-C Motors . . .

. . . with self-contained heat exchanger cooling for operation in highly contaminated atmospheres—*Allis-Chalmers Mfg. Co., Dept. HPAC, Milwaukee.*

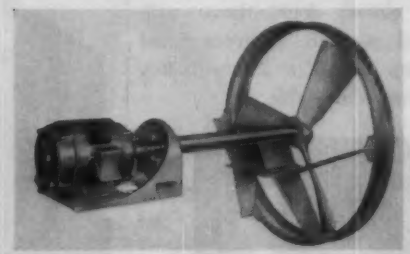
Line of motors are available in constant or adjustable speeds in frame sizes "EB-120" and up and in ratings from 10 through 200 hp. Has independent cooling system, unaffected by speed of motor; thermostatic relay in hot air stream at commutator end shuts down drive or operates alarm in case of blower motor power failure. The d-c motor heat exchanger combination is constructed to allow top, sidewall or ceiling mounting; can be removed for maintenance and removable gasketed covers permit accessibility to d-c motor and commutator. Recommended by manufacturer for machine tool, steel mill drive, paper mill, cement and rubber plant applications.



Humidity and Temperature Recorder . .

. . . *Serdex, Inc., Dept. HPAC,* 12 *Bowdoin Sq., Boston* 14, *Mass.*

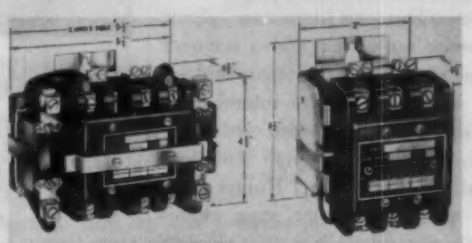
"Model HGS-HYT-1C" provides humidity readings to ± 3 percent RH within operating range of 15 to 95 percent RH at temperatures from 32 to 130 F. Circular animal membrane is used. Temperature reading accurate to ± 1 F over a range of zero to 100 F. Bimetal cantilever temperature sensing element used. Direct reading taken through indicator window in sensing section. Switches provided to establish conditions within control ranges prior to start of automatic control. Sensing section is constructed of aluminum, may be located remotely from monitoring section.



Extension Shaft Fans . . .

. . . designed to exhaust contaminated fumes from installations requiring isolation of fan motor from air stream—*Propellair, Div. of Robbins & Myers, Inc., Dept. HPAC,* 1345 *Lagonda Ave., Springfield, Ohio.*

"Type CE" fans are non-overloading, have operating range from free air to 1½ in. static pressure. Propellers available in multi-blade design, are modern airfoil type of cast aluminum-magnesium alloy. Available in nine diameters to 60 in., fans give air deliveries to 79,000 cfm. Shaft lengths available from 16 to 66 in.

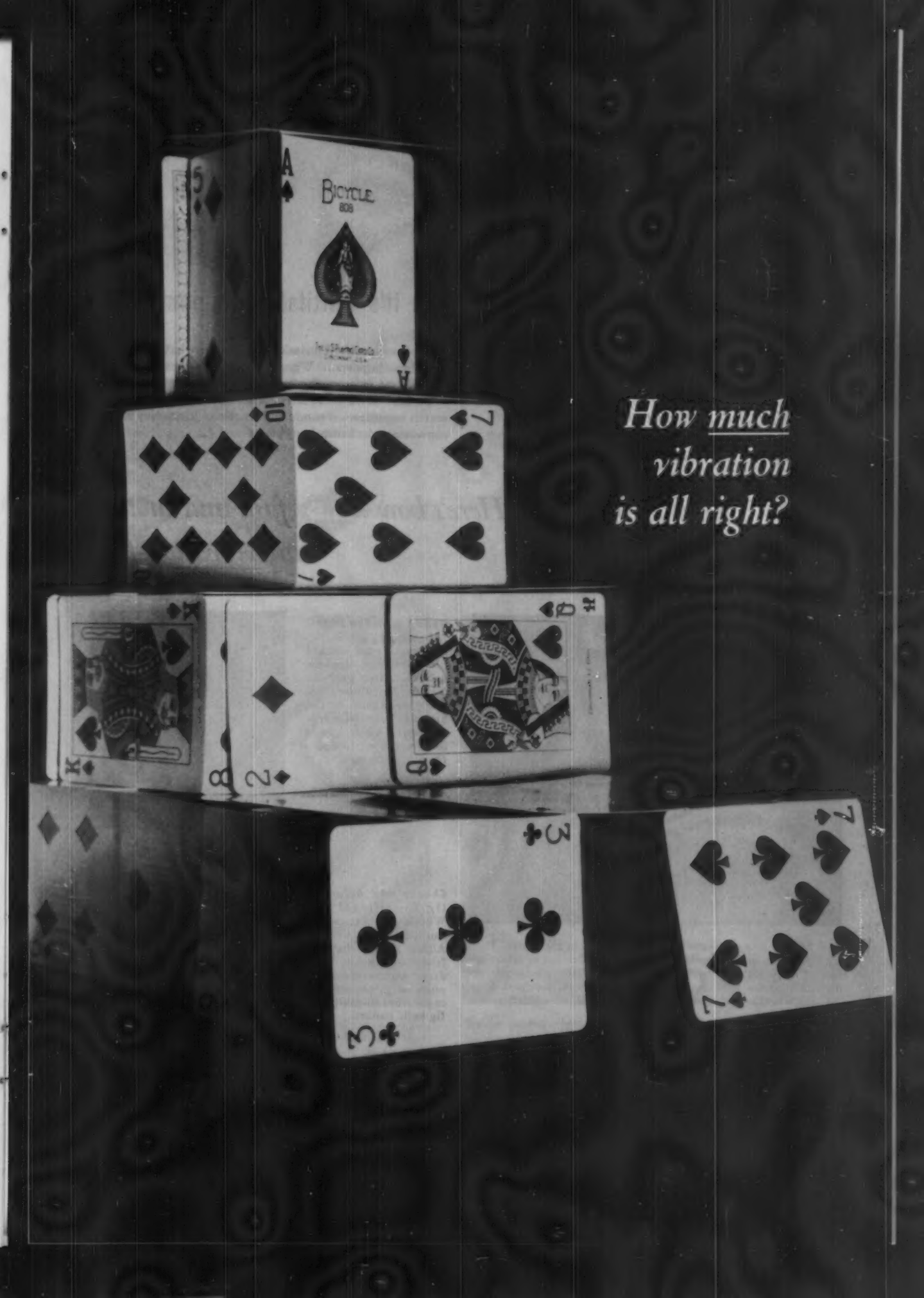


Motor Starters . . .

. . . engineered for controlling commercial air conditioning compressor motors—*Arrow-Hart & Hegeman Electric Co., Dept. HPAC,* 103 *Hawthorn St., Hartford.*

Company's 30 and 50 amp starters and contactors are supplied in two, three and four pole models. Quick trip or standard heaters furnished. Extra poles may be used for fan and damper motors without the need for extra, smaller relays. Coil wattage values for 30 amp models are 29 inrush and 2 watts sealed; for 50 amp models, 85 watts inrush, 7 watts sealed. Coils supplied for all standard voltages. Can be supplied as open units or equipped with NEMA Type I enclosures.

(*Continued on page* 204)


How much
vibration
is all right?

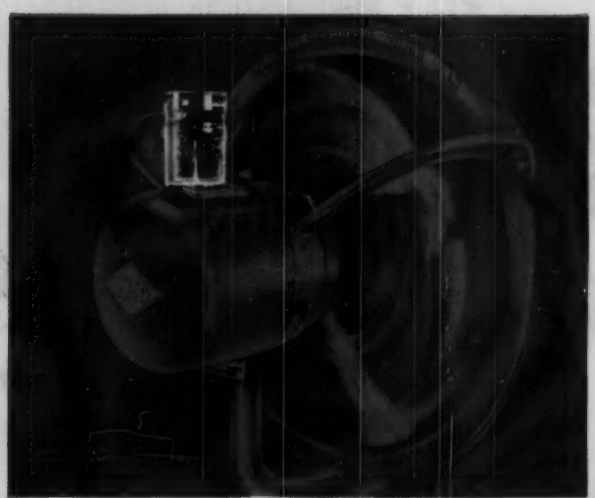
HOW MUCH VIBRATION IS ALL RIGHT?

When it's ventilating equipment...

When *you* specify ventilating equipment, what do *you* consider most important? What features do *you* insist on? What contributes most to the quality of equipment *you* want?

To nail down these answers for us, an independent research organization conducted a nationwide survey among consulting mechanical engineers.

Here's how ILG *fans and motors stay vibration-free*



Full Speed Ahead — and still not a ripple in the water. With Ilg direct-connected propeller fans you get operation as *vibration-free* as it's possible to be. Ilg's "One-Name-Plate" pledge of performance covers *both* the dynamically balanced, patented Type "Q" fan wheel and the permanently lubricated, self-cooled motor.

Ready with the Rotor! All rotating *parts* in Ilg-built motors are checked for static and dynamic balance. After final assembly, Ilg Motors undergo additional checks. Smooth, *vibration-free* operation assures long life—and a quiet one—for *all* Ilg Motors.

Checks and Balances. Ilg Centrifugal Fan Wheels—with Backward Curved (BC) Blades and Airfoil design—have to "check out" before being direct-connected to 3-phase or permanent-split capacitor, single-phase Ilg-built motors.

For fans built to satisfy your "specs"...

consulting engineers vote for vibration-free fans on 9 ballots out of 10

Results of the poll? Nine times out of ten *vibration-free operation* ranks foremost among those who specify fans and ventilating equipment.

As shown below, Ilg Fans and Ventilators are as *vibration-free* as it's possible to be. But that's only *one* reason why it pays to choose Ilg. Not to be overlooked are these additional points preferred by consulting engineers: minimum maintenance, low operating costs, ease of repair, quietness.

For further details of why Ilg rates so high with those who specify, send for Catalog No. 153 on propeller fans, Bulletin No. 257 on Airfoil centrifugals, Bulletins 2301 and 2700 on power roof ventilators.

ILG *power roof ventilators cost less to operate*

Look Under the Hood of this Ilg Power Roof Ventilator and you'll see why it's such a popular purchase. Ilg Backward Curved Aluminum Airfoil Centrifugal Fans assure smooth, quiet air flow and low shock loss. Permanently lubricated, self-cooled, direct-connected Ilg Motors eliminate belt maintenance, friction losses, slippage.

David and Goliath? Just name the exhaust or supply propeller fan power roof ventilator that fits your capacity and kind-of-building needs—and Ilg has it. 11 different sizes, all direct-connected fan and motor for quiet, *vibration-free* operation and low maintenance. All components dynamically balanced for lifetime alignment.

specify ILG

ILG ELECTRIC VENTILATING COMPANY
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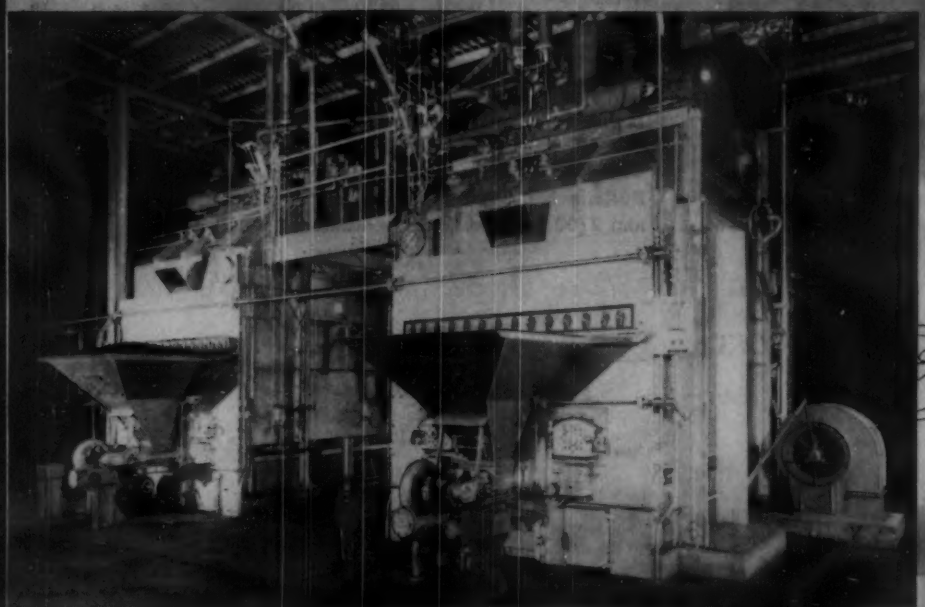
Offices in 57 Principal Cities

DETROIT STOKERS HELP REDUCE COST OF STEAM AT PINEHURST

The Detroit Stoker Equipped Steam Plant at this Famous North Carolina Resort Serves three Hotels, seven other buildings



Steam Plant, Pinehurst, Incorporated, showing Detroit Single Retort Stokers. Boilers are Babcock & Wilcox Integral Furnace Type FF.
John F. Taylor, *Manager Utilities* . . .
Wiley & Wilson, *Consulting Engineers*, Richmond, Va.

The Carolina Hotel, Pinehurst, N. C.—the largest of the three hotels served by this modern plant.

Cost of steam per thousand pounds has been reduced 33.4% by the new stoker—boiler installation, according to Mr. John F. Taylor, Utilities Manager, Pinehurst, Incorporated, Pinehurst, N. C. Amount of steam generated per pound of coal has been increased 22%.

The stokers are Detroit Single Retort Underfeed motor driven . . . the boilers are B&W Integral Furnace Type FF. A master regulator is connected to the Detroit Adjustable Feed Control on each stoker and to the adjustable damper of each motor-driven fan to regulate fuel and air in proportion to the load.

Detroit Underfeed Stokers provide high efficiency at low operating cost with small and medium size boilers.

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Wherever your plans call for a high velocity air conditioning system—whether you're designing a new structure or remodeling an old one—choose Connor high velocity valve attenuators . . . there's a model that meets every design and performance test.

Request new 24 page Bulletin K33-A, which includes selection data on Connor equipment and special information for the design of *any* High Velocity system.

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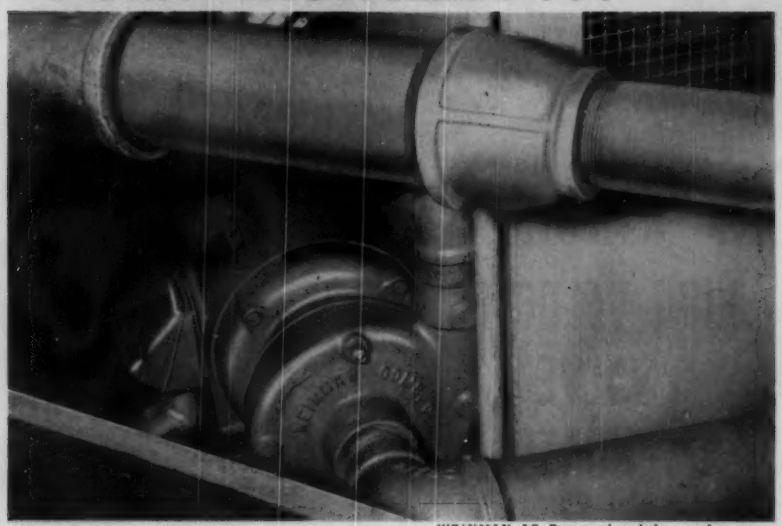
ONE WEINMAN TYPE AC PUMP INSTALLED...



WEINMAN AC Pump circulates water over cooling tower for 20-ton air conditioning unit at General Electric Supply Co., Columbus, Ohio

all air conditioning pumping worries over!

Hot and chilled water circulation through cooling towers, condensers or heating systems . . . pressure boosting . . . and many other general *and* specialized pumping needs can be solved quickly, efficiently and economically with WEINMAN Type AC Unipumps.

These pumps are highly flexible, extremely versatile. Installation is simple and inexpensive. Even installation in confined areas is easy because of the flexible mounting features of this compact pump. WEINMAN Type AC Pumps can be *mounted in any position* on floor, ceiling or wall, with the shaft horizontal, vertical or at an angle.

WEINMAN Type AC Unipumps are Close Coupled . . . single stage . . . single suction . . . have output ratings to 260 gpm . . . heads to 150 feet . . . a horsepower range from ¼ to 7½!

Your nearest WEINMAN PUMPS SPECIALIST can give you full information on *all* WEINMAN Pumps. Call him . . . you'll find his name listed in the yellow pages of your phone book.

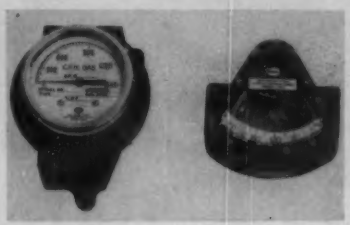
It will pay you to get the full story about WEINMAN *Type AC Unipumps. Today . . . write for your free copy of* WEINMAN'S *illustrated Bulletin No. 100 showing dimensions, specifications, features, selection table and performance curves.*

THE WEINMAN PUMP MFG. CO.
290 SPRUCE ST. COLUMBUS 8, OHIO

Centrifugal Specialists

EQUIPMENT DEVELOPMENTS

Continued from page 198



Flow Meter . . .

. . . with aluminum and brass bodies for pressures to 2000 psig, special body materials for corrosive applications—*Seico Instrument Div., Eclipse Fuel Engineering Co., Dept. HPAC,* 1139 *Buchanan St., Rockford, Ill.*

Flow meter scale ranges from zero to 6 gph (zero to 0.1 gpm) to zero to 6000 gph. For scale ranges to 20 gpm, meters available for direct installation in flow lines. "Series 1050" gas flow models available with ranges zero to 30 cfh (zero to 0.5 cfm) up to 2400 to 60,000 cfh. For scale ranges to 50 cfm, meters installed directly in flow lines. Gas flow instruments have gear-driven pointer with 4½ or 6 in. round dials and 180 or 240 deg scales. All instruments hermetically sealed, can be installed in vertical or horizontal position.

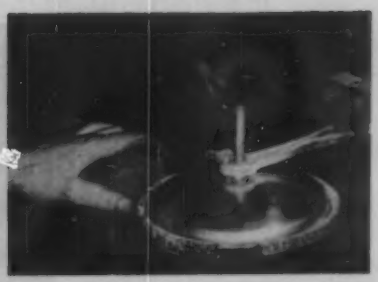
Incombustible Ducts . . .

. . . from insulation board of long-fibered asbestos bonded under high pressure steam with silica—*North American Asbestos Corp., Dept. HPAC,* 3210 *Board of Trade Bldg.,* 141 *W. Jackson Blvd., Chicago* 4.

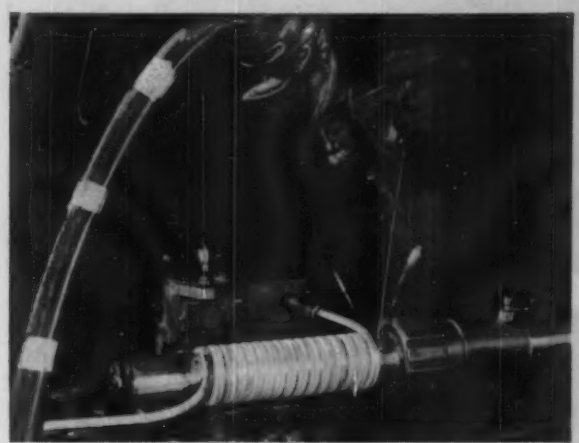
"Asbestolux" weighs approximately 14 oz per sq ft in ¼ in. thickness, resistant to temperatures to 2300 F. Available in ¼ or ⅜ in. thicknesses, shipped in 4 x 8 ft sheets. Resistant to fire, heat, moisture, steam, chemicals, corrosion.

1. Here, hand-fed SIL-FOS is torch-brazed to make the joint connecting hot water line to hot tank.

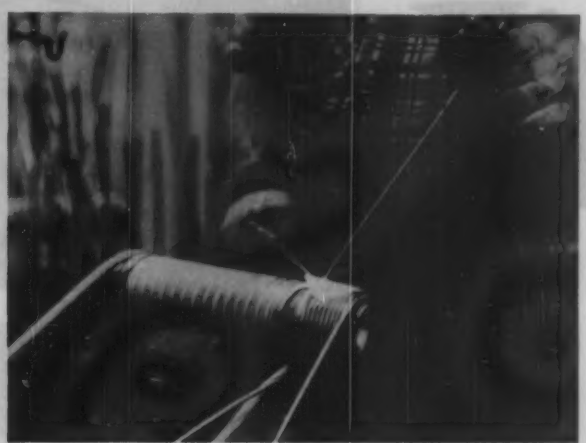
2. Operator "ties in" Oasis condenser with EASY-FLO wire. Compressor joints also are brazed with EASY-FLO.



3. Induction heating and preform ring of SIL-FOS is used to join water line to top of hot tank.



4. Unique lathe-turning method is used to wind pre-cooler coils. Here, operator hand-feeds Handy & Harman SIL-FOS anchoring coil end to jacket. Note finished joint at other end.



5. Operator brazes condenser coil on same jacket as finished pre-cooler coil. Same winding method is used to wrap coil around jacket. Hand torch and SIL-FOS are used.

Here's How HANDY & HARMAN Silver Brazing Is Used in 5 Components of the "Oasis Hot 'N Cold" Water Cooler

Five different assemblies, three kinds of metal—copper, brass and stainless steel... two heating methods—hand-torch and induction...and both preform and hand-fed brazing alloys are used in the fabrication of the "Oasis Hot 'N Cold" Water Coolers, manufactured by Ebco Manufacturing Company, Columbus, Ohio.

In this instance, silver alloy brazing runs the gamut of benefits; meeting the complete range of joint types and variety of metals joined, ease of application, economy, strength, mass production and flexibility of alloy use... under temperatures that virtually exclude other metal-joining methods.

Whatever you contemplate—one or five (or more) joints in one or more products or parts—you will do well to take a close look at the advantages of Handy & Harman silver alloy brazing. The closer you look, the more you realize that its benefits are numerous, immediate, and, very probably, readily applicable to your product, part or method.

6. Completed "Oasis Hot 'N Cold" Water Cooler. Compartments are for storage of soups, coffee and other instant beverages.

GET THE FACTS FROM BULLETIN 20

This informative booklet gives a good picture of silver brazing and its benefits...includes details on alloys, heating methods, joint design and production techniques. Write for your copy.

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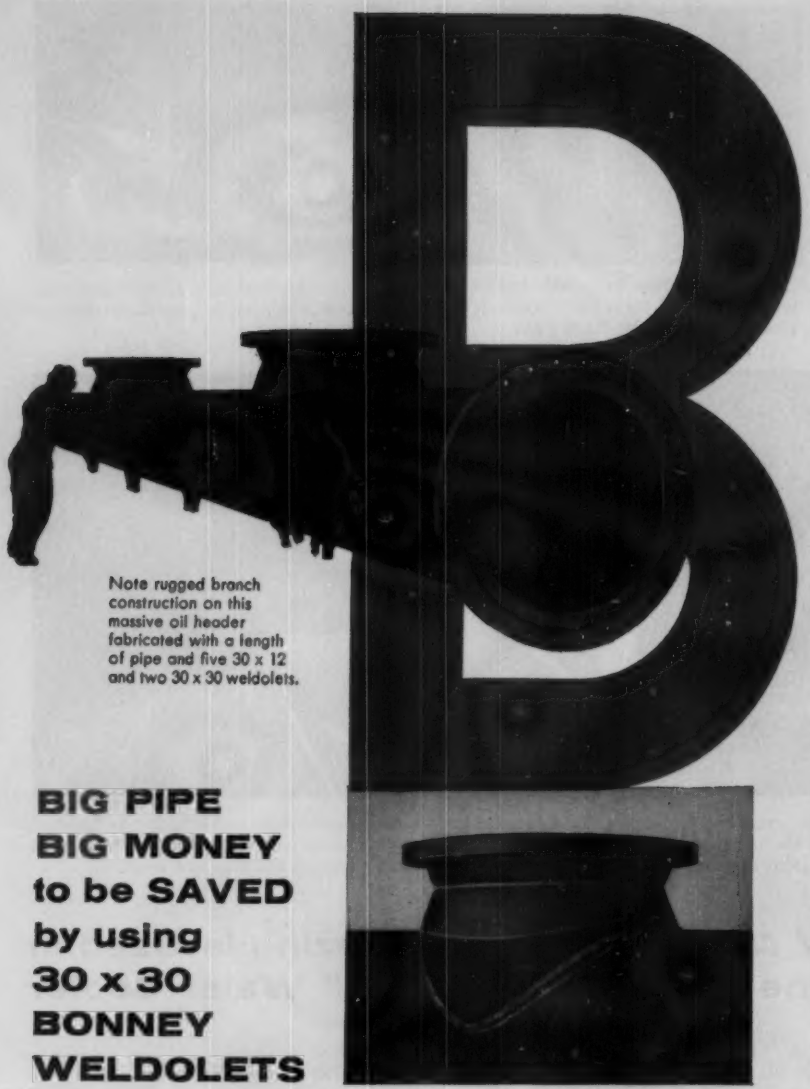

Note rugged branch construction on this massive oil header fabricated with a length of pipe and five 30 x 12 and two 30 x 30 weldolets.

BIG PIPE BIG MONEY to be SAVED by using 30 x 30 BONNEY WELDOLETS

Closer manifolding, ease and speed of field fabrication without header distortion, lower purchase and welding costs are just a few of the profit benefits of header fabrication with Bonney Weldolets. Today there is particular need for reducing costs. Bonney Forge can provide this opportunity for cutting costs in your company. Write, phone or wire for details.

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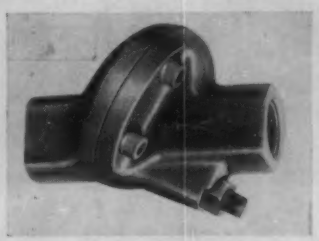
EQUIPMENT DEVELOPMENTS

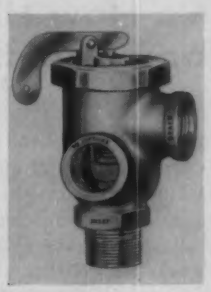
Continued



Flow Control Valve . . .

. . . designed to permit precise control of air, gas, low pressure hydraulic flow with unrestricted return—*Valvair Corp., Dept. HPAC,* 454 *Morgan Ave., Akron, Ohio.*

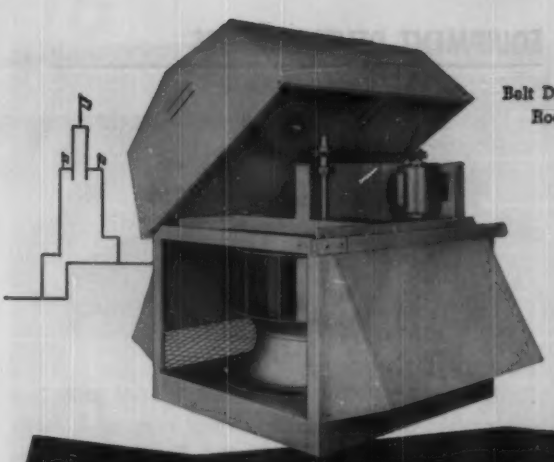
"Micro-Trol" has locked screw adjustment, combination of controlling elements, threaded stem, molded nylon flapper. Lower range of flow rates metered by adjusting position of ground cylindrical stem within concentric bore in valve body. As stem clears bore, stem end contacts flapper, lifting it off seat; flow controlled by clearance between flapper and seat. Available in sizes ¼ through ¾ in. NPT. Valve body is of cast Navy M bronze, stem is stainless steel and flapper is molded nylon. An o-ring seals, retains stem.



Relief Valves . . .

. . . for automatic storage type water heaters, storage tanks, booster heaters —*A. W. Cash Valve Mfg. Corp. Dept. HPAC, Box* 551, *Decatur* 60, *Ill.*

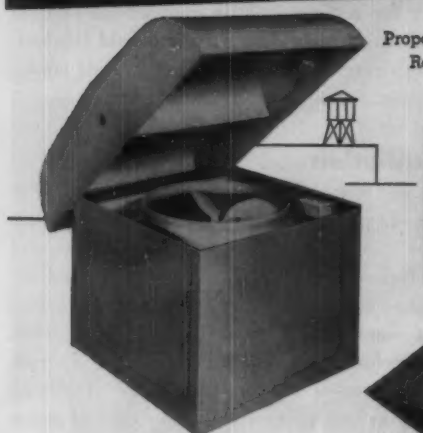
Company's new "Type FV Series" valves are self-closing combination temperature and pressure relief type. Eleven different models in selection of pipe sizes, optional male or female inlet connections, with or without fixture connections. Valves are of bronze construction, with thermostatic element which actuates valve when temperatures become too high.



Belt Drive Centrifugal
Roof Ventilator

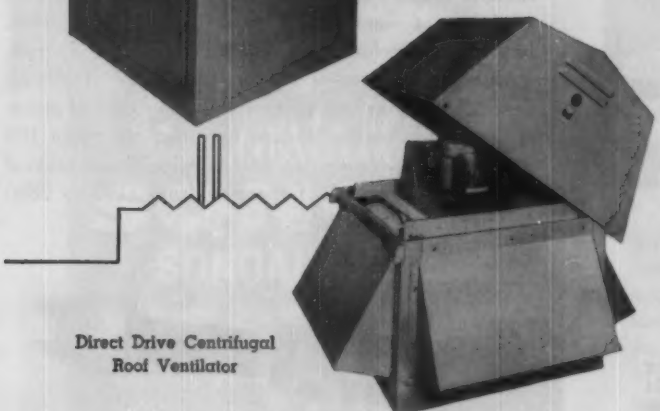
Recommended for their high quality, ease of installation, low maintenance cost, trouble-free operation, space-saving features, and blower-like performance.

Peerless Electric Roof Ventilators . . .



Propeller-Type Power
Roof Ventilator

Peerless Electric Roof Ventilators offer engineers, architects, contractors and users AMCA rated units that embody sturdiness, high performance ratings, and low noise levels. They are particularly suited for public buildings, industrial plants, hospitals, churches, schools, and other similar applications.



Direct Drive Centrifugal
Roof Ventilator

Sizes range from 12" to 60" wheels; 640 to 45,000 c.f.m., depending upon the unit selected. Peerless Electric Roof Ventilators are built of 16 gage steel, or heavier, to last the life of the building. They fit all standard curb sizes. Matching wheel cones accurately fit venturi inlet for quieter operation . . . smoother air movement.

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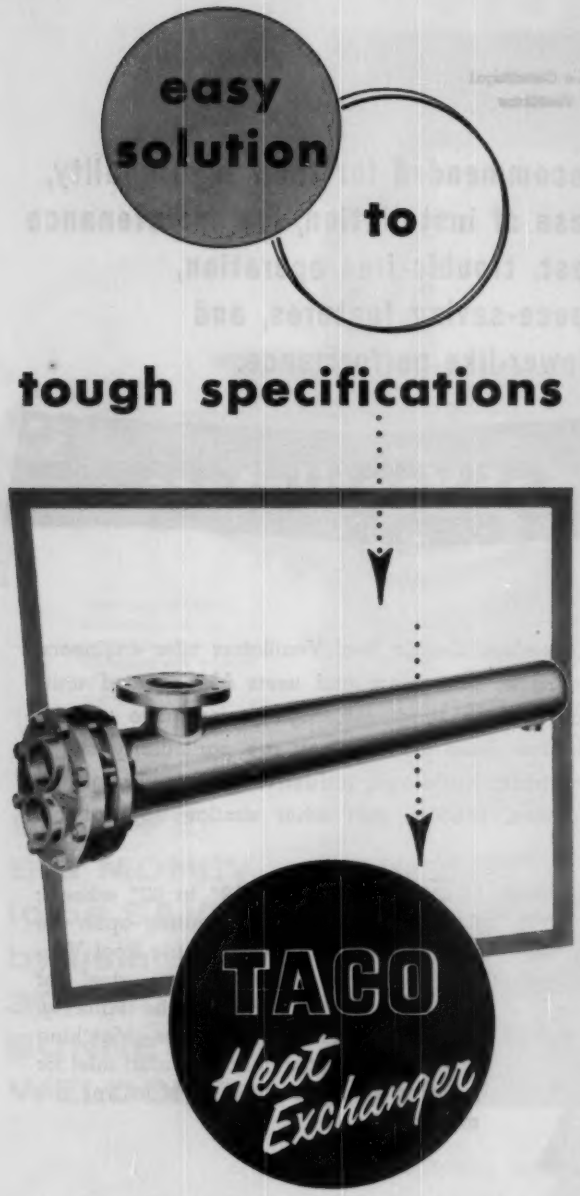

Whatever your requirements — simple or complex — Taco can supply you immediately with the right heat exchanger! TACO know-how will help you select the heat exchanger you can depend upon to do the job right!

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EQUIPMENT DEVELOPMENTS

Continued

Power Driver

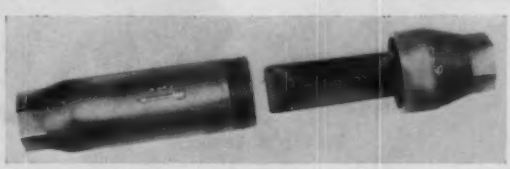
...developed for driving threaded, headed studs into concrete, steel with blank cartridge energy—*Velocity Power Tool Co., Dept. HPAC,* 201 *N. Braddock Ave., Pittsburgh* 8.

"Green Hornet" driver has trigger activation, push type replacement of barrel units. Recommended by manufacturer for setting studs in commercial and industrial building operation, for shop and field fabricating, installing electrical heating, piping and air conditioning facilities. Studs ¼ or ⅜ in. can be set.

Finned Radiation . . .

...intended for school buildings—*American Air Filter Co., Inc., Dept. HPAC,* 215 *Central Ave., Louisville* 8.

"Herman Nelson Type Q" finned radiation and enclosures employ concealed fasteners, rounded corners, minimum of seams and a cover front free of grilles, impressions, deformations. Heating element is constructed from seamless copper tubing and aluminum fins. All elements can be used with any type of steam or hot water heating system for pressures up to 100 psig and temperatures to 330 F, with either manual or automatic controls. Capacities from 1130 to 2840 Btu per lineal ft available.

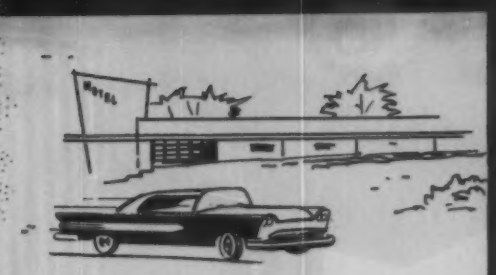


Check Valve . . .

...with synthetic rubber element molded to threaded nipple at intake end of valve—*Harman Equipment Co., Dept. HPAC,* 3605 *E. Olympic Blvd., Los Angeles* 23.

Soft, resilient valve element on "Permatite" check valve reduces line shock, absorbs foreign matter as slotted end of tube seals under vacuum and pressure conditions as flow is stopped. May be used with water, gasoline, crude oil, refined oil, any chemical that will not attack rubber. Element can be added to any standard pipe fitting, may be used as foot valve, vertical or horizontal check valve, or angle valve in suction or discharge line. Now stocked in ¾ in. size.

Up your profits



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SONOCO Sonoairduct enables you to save installation time, labor and money — without lowering the quality of construction! Easy to handle — levels quickly. Made in 23 sizes — 2" to 36" I. D., with the larger diameters ideal as supply and return lines for motels, schools, shopping centers, churches, and industrial heating and cooling where duct is encased in concrete. Meets and exceeds F. H. A. criteria and test requirements for this type product.

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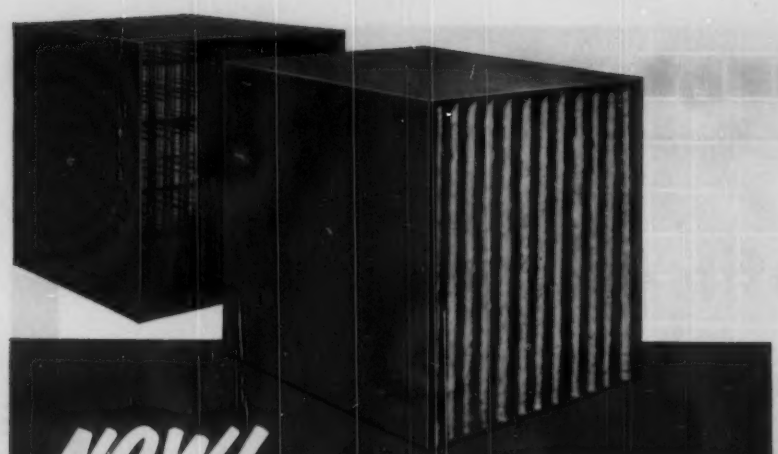


NOW! Cambridge AEROSOLVE® Filters Available in HIGH VELOCITY MODELS!

80% More Air per sq. ft. face area

45% Less Area per given cfm.

. . . at No Increase in Pressure Drop

Already famous for its low owning and operating cost, the Cambridge AEROSOLVE Filter in the new high-velocity models offers even greater economies. Compare:

	High-Velocity AEROSOLVE	Standard AEROSOLVE
Rated Capacity (24" x 24" face area)	1800 cfm.	1000 cfm.
Face Velocity	450 fpm.	250 fpm.
Area of Filter Medium	86 sq. ft.	43 sq. ft.
Ratio, Filter Area to Face Area	21.50 to 1	10.75 to 1

Choice of 3 Efficiencies

High-velocity AEROSOLVE cartridges are, like the Standard models, available in efficiencies of approximately 95%, 85% and 35% (discoloration test with atmospheric dust). All cartridges are interchangeable and are easily secured in permanent cadmium-plated frames by quick-acting fasteners at the corners. No other strainer-type air filter of comparable efficiency approaches the low pressure drop of these units.

Other than infrequent cartridge changes, AEROSOLVE filters require no maintenance. Installation is also low in cost. In high-velocity systems, the new units obviate the need of V-ing the filter bank and result in even greater installation and maintenance economies.

Write for Bulletin 130

Cambridge Filter Corporation

732 E. Erie Blvd., Syracuse 3, N. Y.

Makers of the ABSOLUTE® Filter— World's Most Efficient Air Cleaning Device

REPRESENTATIVES IN PRINCIPAL CITIES

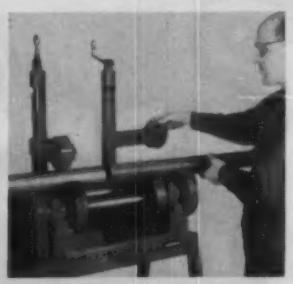
EQUIPMENT DEVELOPMENTS

Continued

Pipe Vise . . .

. . .incorporating design improvements—*Toledo Pipe Threading Machine Co., Dept. HPAC,* 1445 *Summit St., Toledo* 4.

Pipe vise stand "8A" has mounting holes for most vices, elastic stop nuts for all fastened elements, says manufacturer. New steel tray said to prevent folding while in use. Rubber foot pads designed to prevent scratching, marring. Other features cited: three integral pipe benders, pipe rest, adjustable bracket for use with ceiling brace. Pipe stand can be carried by one man.



Pipe Rotator . . .

. . .designed to simplify and speed prewelding of long pipe runs before erection—*Cecil C. Peck Co., Dept. HPAC,* 14901 *Woodworth Rd., Cleveland* 10.

"Jr" model is intended for maintenance operations of industrial, food, chemical processing plants where power and process piping requires continuous attention. Pipe rotator is powered by ¼ hp capacitor 110 volt motor through adjustable speed v-belt transmission with 2-1 stepdown gearing. Welding speed range is 7 to 14 in. per min. Complete unit weighs less than 200 lb. ≠

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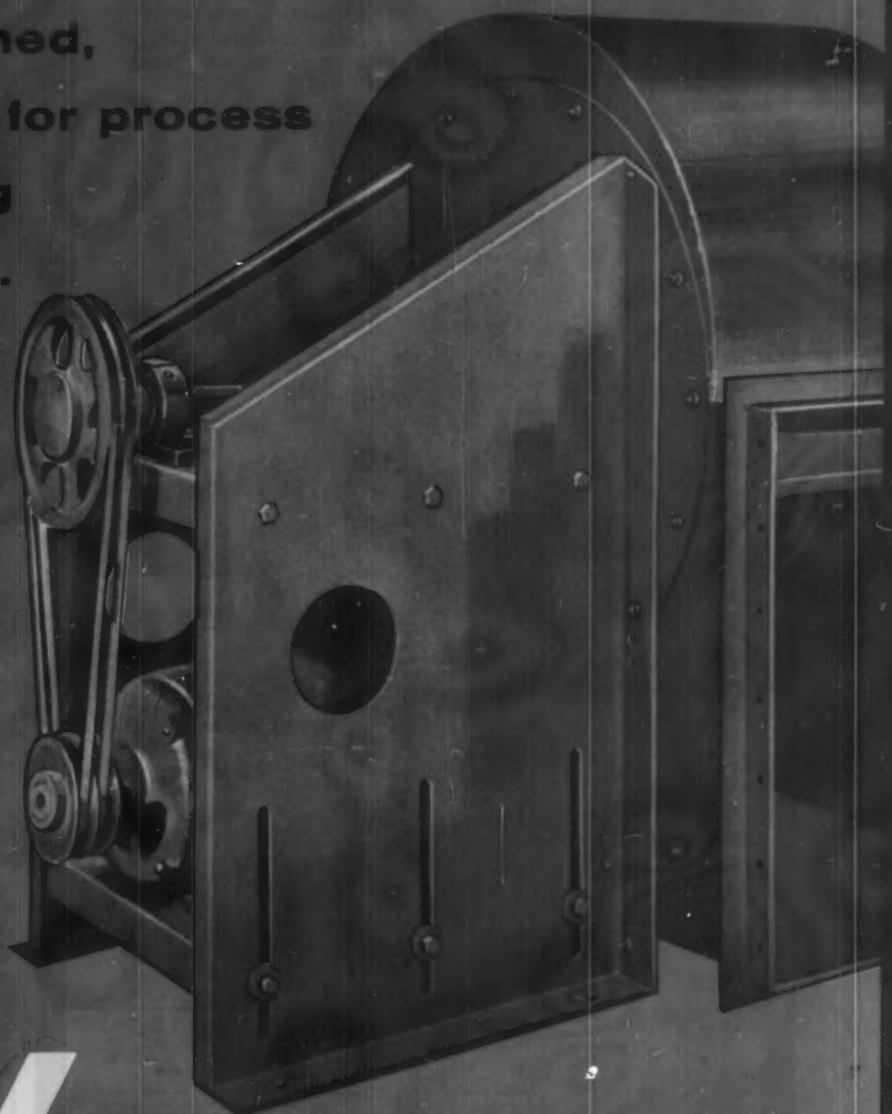
GENERAL PURPOSE FANS

. . . self-contained, portable units for process and ventilating applications . . .

From design through maintenance, present day air handling problems demand BIG performance from fans. And General Purpose Fans do the job, give you that BIG performance. They're made in four types, 12 basic sizes, with capacities from 160 to 19,070 Cfm; in both constant speed units with direct connected motors and adjustable speed units with V-belt drives and integral mounted motors; particularly for use with duct systems. Send for Bulletin 563.



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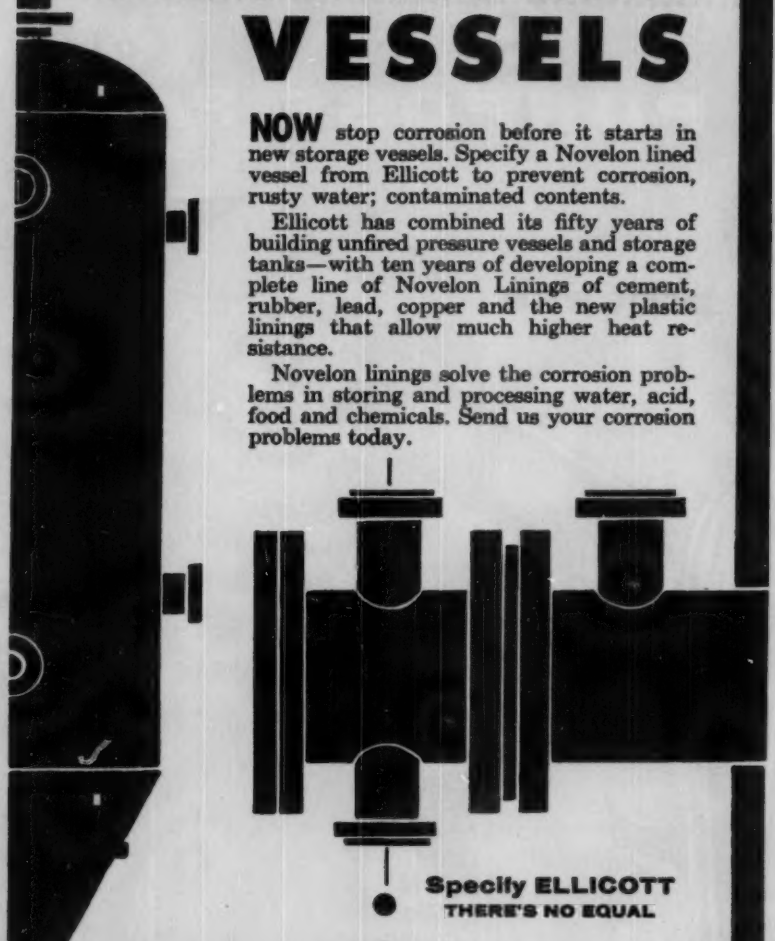
Announcing CORROSION CONTROLLED VESSELS

NOW stop corrosion before it starts in new storage vessels. Specify a Novelon lined vessel from Ellicott to prevent corrosion, rusty water; contaminated contents.

Ellicott has combined its fifty years of building unfired pressure vessels and storage tanks—with ten years of developing a complete line of Novelon Linings of cement, rubber, lead, copper and the new plastic linings that allow much higher heat resistance.

Novelon linings solve the corrosion problems in storing and processing water, acid, food and chemicals. Send us your corrosion problems today.



Specify ELLICOTT
THERE'S NO EQUAL

ELLICOTT
FABRICATORS, INC.
SUBSIDIARY OF
ELLICOTT MACHINE CORPORATION

HOT WATER GENERATORS

STORAGE TANKS

SPECIAL LININGS

SPECIAL FABRICATION

Representatives in Major Cities

Clare and Kloman Streets • Baltimore 30, Maryland

RECENT TRADE LITERATURE . . .

▸ *AIR CONDITIONERS*—Bulletins "133," "137" and "138" give information on company's new "Type C" series of air conditioners (coil surface type), fan coolers, refrigerant condensers. Machines fully described, illustrated with photographs, diagrams. Tables of physical data, capacities included. *Niagara Blower Co., Dept. HPAC,* 405 *Lexington Ave., New York* 17.

▸ *AUTOMATIC FILTERS*—Bulletin "701" discusses automatic filters, other heating, ventilating, air conditioning equipment. "Roll-O-Vent" automatic filter section featured in new bulletin, which also includes illustrations, descriptions of "Herman Nelson" convector radiators, finned radiation, unit heaters, console heaters, propeller fans, unit blowers, industrial exhausters, centrifugal fans. Bulletin has 17 charts outlining performances, capacities, dimensions, range, cfm, hp ratings, unit arrangements. *American Air Filter Co., Inc., Dept. PD-HPAC,* 215 *Central Ave., Louisville* 8.

▸ *BALL VALVE*—Illustrated, 4 page catalog "WV454" presents manufacturer's "Econ-o-'miser' " ball valve designed to serve as valve and union. Features outlined in text of publication; illustrations include photos, diagrams, cutaway drawings. Tables give cost savings, dimensions, specifications. *Worcester Valve Co., Inc., Dept. HPAC,* 16 *Parker St., Worcester, Mass.*

▸ *BOILERS*—"Forty Facts You Should Know About Kewanee Boilers" is title of new booklet which discusses characteristics of company's high and low pressure, Scotch and firebox boilers. Four parts of booklet deal with company as manufacturer of steel firetube boilers, principles of design, boiler construction, special features of Scotch type boilers. *Amer-*

Complete-line air-conditioning lets Worthington dealers

CUSTOM-QUOTE EVERY JOB!

Probably the most complete line of air conditioning equipment in the world—*Worthington, naturally*—is signing on a select group of new air conditioning dealers—*yourself, possibly?*

Many, many different models permit these *fortunate* dealers to put together the most efficient and economical combinations of air conditioning equipment for any *specific* job. Handling *exactly* the right equipment for every air conditioning problem eliminates equipment compromises, means these *smart* dealers can "custom-quote" on every job. And behind this job-tailored equipment stands 70 years of respected Worthington experience and front-line service. (Incidentally, these same *intelligent* new dealers will find that Worthington equipment is backed by a 5-year warranty which includes a generous dealer labor allowance.)

Interested in quoting on equipment fashioned to the job, not jobs fashioned to the equipment? Interested in increasing your sales, cutting down on lost orders? If so, *Worthington wants you—and you'll want Worthington.* Write today for the complete air conditioning story. Worthington Corporation, Air Conditioning and Refrigeration Division, Section 12-4, Harrison, N. J.

WORTHINGTON

WORTHINGTON'S COMPLETE COMMERCIAL AND INDUSTRIAL AIR CONDITIONING LINE INCLUDES:

Flexi-cool line: Air-cooled, ceiling-mounted, split systems • Water-cooled, self-contained, ceiling-mounted units • Smallest floor-mounted unit available • Hang it, lay it down, stand it up • Vertical and Horizontal cooling coils • Remote water-cooled packaged unit • Water-cooled self-contained packaged unit • Air-cooled packaged units • Air-cooled condensers • Air-cooled condensing units • Packaged water-chillers—hermetic and open • Reciprocating compressors • Air handling units • Evaporative coolers • Evaporative condensers • Fan and coil units

Another First from **DOVER**

The First Packaged Cooling Tower with

SELF-CLEANSING BASIN and ALL-PURPOSE Right-Angle UTILITY SUMP

Series CF
Horizontal Induced Draft
2 to 200 tons capacity

Dover adds another first to an already impressive list of achievements in the cooling tower industry.

The Dover self-cleansing basin and all-purpose right angle utility sump bring you such advantages as:

SLOPING BASIN . . . basin collects all mud and debris in one section for easy removal through sump flush-out opening.

MUD RISER PROTECTS PUMPING SYSTEM . . . suction line and pump are protected against air intake and harmful foreign matter.

DRAIN DRY FEATURE . . . right angle sump can be adjusted so that basin drains dry each time system shuts off . . . simplifies servicing and winter shut-down.

EASY FIELD HOOK-UP . . . right angle sump provides bottom suction with side pipe-up . . . eliminates need of costly grillage to elevate tower. Tower rests on its own skids.

DOVER
MANUFACTURING COMPANY
Dept. 100, 3117 Weatherford Avenue
Independence, Missouri

FULL DETAILS . . . are yours for the asking. Just a note will do. We'll send you all the information you want and need on the all new Dover Series CF towers. Write today!

RECENT TRADE LITERATURE

Continued

ican-Standard, Kewanee Boiler Div., Dept. HPAC, 101 *Franklin St., Kewanee, Ill.*

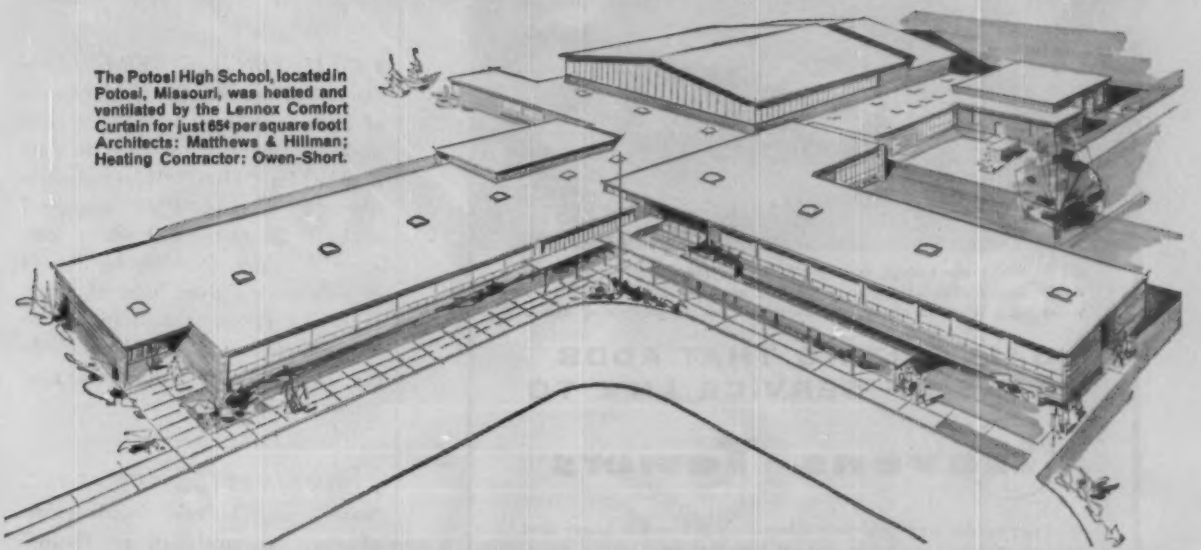
▸ *BRAZING MANUAL*—New book is for self-instruction, classroom or on-the-job training in metals joinery. Intended for service trades, contains illustrated data for brazing shapes, sheet, castings, tubing, assemblies of copper, brass, steel, aluminum, cast iron. Brazing applications in air conditioning, heating, piping service trades covered. *All-State Welding Alloys Co., Inc., Dept. HPAC,* 249-55 *Ferris Ave., White Plains, N. Y.*

▸ *CANNED MOTOR PUMPS*—Revised 4 page bulletin details features, specifications of company's line of pumps for general process pumping. Performance curves for pumps to 15 hp, dimensions, principles of construction and operation, cutaway views, materials available, power requirements, other descriptive material all included. "Series C. Chempumps" intended for pumping of corrosive, toxic, radioactive, other fluids at heads to 275 ft, capacities to 600 gpm. *Chempump Corp.,* 1300 *E. Mermaid Lane, Philadelphia* 18.

▸ *CENTRIFUGAL FAN*—Bulletin added to company's "Lungs for Industry" program describes backward-blade centrifugal fans incorporating new construction features for easier maintenance. Bulletin includes engineering data, full specifications, performance tables, selection and arrangement information on 19 basic size centrifugal fans for use in heating, ventilating, air conditioning systems, power plant installations, industrial processes. *General Blower Co., Dept. HPAC,* 8610 *Ferris Ave., Morton Grove, Ill.*

▸ *CLAMPS, COUPLINGS*—File of brochures covers line of clamps, couplings, joints for industrial uses. Brochures provide information on applications, sizes, dimensions of prod-

Potosi school gets the finest in fresh air heating and ventilating—installed complete with automatic controls—for just 65¢ per square foot!



The Potosi High School, located in Potosi, Missouri, was heated and ventilated by the Lennox Comfort Curtain for just 65¢ per square foot! Architects: Matthews & Hillman; Heating Contractor: Owen-Short.

New Lennox Comfort Curtain System automatically draws in fresh air from outside . . . warms, cleans and circulates air quietly and evenly throughout the classroom!

Hard to believe, isn't it?—that after all these years a new and better fresh air heating and ventilating system can be installed *for a fraction of the cost* of systems used previously. Yet it's true! 65¢ per square foot was the *complete* cost of the Lennox Comfort Curtain System in the Potosi, Missouri High School. Including fully automatic controls, ductwork, labor—everything!

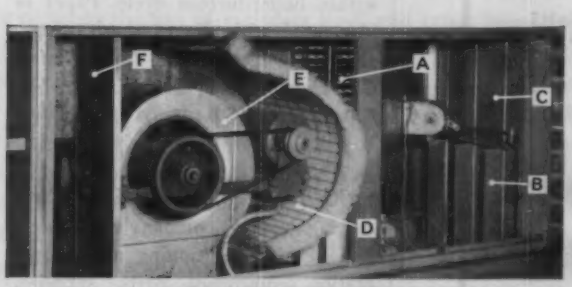
Of course, 65¢ per square foot is unusually low, even for the Comfort Curtain. But costs of $1.03 in Indiana, $1.15 in Montana, and $1.12 in South Dakota are *usual and typical* of the amazing savings offered by the Lennox Comfort Curtain.

How is this possible? The Lennox Comfort Curtain System applies to schools the sound, tested principles of warm air heating. It eliminates expensive pipes, boilers and chimneys. Moreover, it saves hundreds of dollars per classroom per year *every* year it is in use. Fuel is consumed only when heat is required, maintenance is amazingly simple and low-cost. Yet—and this is important—the Lennox Comfort Curtain System does a far better job than costlier systems used previously.

It provides a full, even flow of air throughout the entire length of the exposed classroom wall. It is amazingly quiet. And it holds room temperatures to a variance of six-tenths of one degree, circulates air continuously for perfect distribution, introduces a continuous supply of fresh air into the daytime heating cycle, and provides *tons* of needed fresh air cooling without the cost of refrigeration!

Get full information on this new low-cost system of classroom heating and ventilating. Send coupon below for free booklet, today!

LENNOX



Lennox Air Processing Unit introduces fresh air in adjustable volumes (A); transmits warm air (B) from adjacent or remote heating unit; continuously recirculates indoor air (C); filters air clean (D). Lennox' exclusive floating blower (E) and acoustical lining (F) assure a degree of quietness never before achieved.

© 1958 Lennox Industries Inc., Heating and Air Conditioning, founded 1895; Des Moines and Marshalltown, Ia.; Syracuse, N. Y.; Columbus, O.; Decatur, Ga.; Ft. Worth; Los Angeles; Salt Lake City. In Canada: Toronto, Montreal, Calgary, Vancouver, Winnipeg.

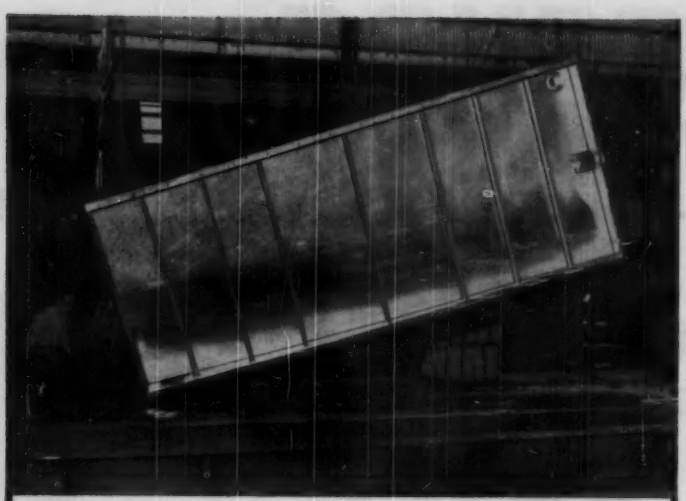
Lennox Industries Inc., Dept. HP-84
1701 E. Euclid Ave., Des Moines 5, Iowa

Gentlemen: Please send me your free booklet on the Comfort Curtain system of classroom heating and ventilating.

NAME_____

ADDRESS_____

CITY_____ ZONE____ STATE_____



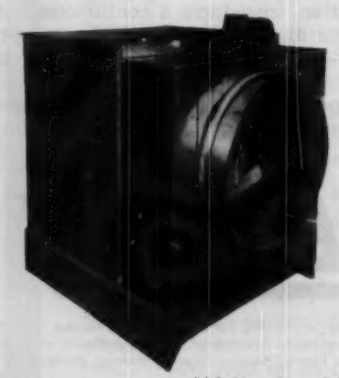
All Havens' tower casings, from the largest to the smallest models, are double-dipped after fabrication and before assembly. 100 Ton "V" series water basin is shown above after removal from the galvanizing kettle.

GALVANIZING THAT ADDS YEARS OF SERVICE LIFE TO

Havens Towers

Rigorous service and field tests adequately prove that heavy zinc coatings provide protection against rust for many, many years. Havens' specialized galvanizing process utilizes acid dipping, zinc ammonium chloride pre-flux and unhurried hot dip. The dip kettle is 50 inches wide, 60 inches deep and 25 feet in length. A quarter of a million pounds of molten zinc are maintained at 840° F. Material being galvanized is left in the dip until temperature is equalized. Over 2 ounces of molten zinc are applied to every square foot exposed, equal to a thickness of .0036 inches.

From pickling and pre-fluxing, through the galvanizing, Havens' Tower casings are adequately prepared to combat rust and corrosion.



FEATURES:

- Fan Screen
- Belt Guard
- Weather Protected Motors
- Stainless Steel Fan Shaft
- Sheaves, Corrosion Resistant Cast Iron
- Steel Sheets—Heavy Guage Hot Rolled Mild Steel

33 SERIES
3 TO 75 TONS
"V" SERIES ALSO AVAILABLE
80 THROUGH 600 TONS

Write for Literature

PERFORMANCE PROVED

Havens

COOLING TOWERS

Division of
HAVENS STRUCTURAL STEEL COMPANY
1713 CRYSTAL AVE., Kansas City 26, Missouri
MEMBER OF ARI COOLING TOWER SECTION

RECENT TRADE LITERATURE

Continued

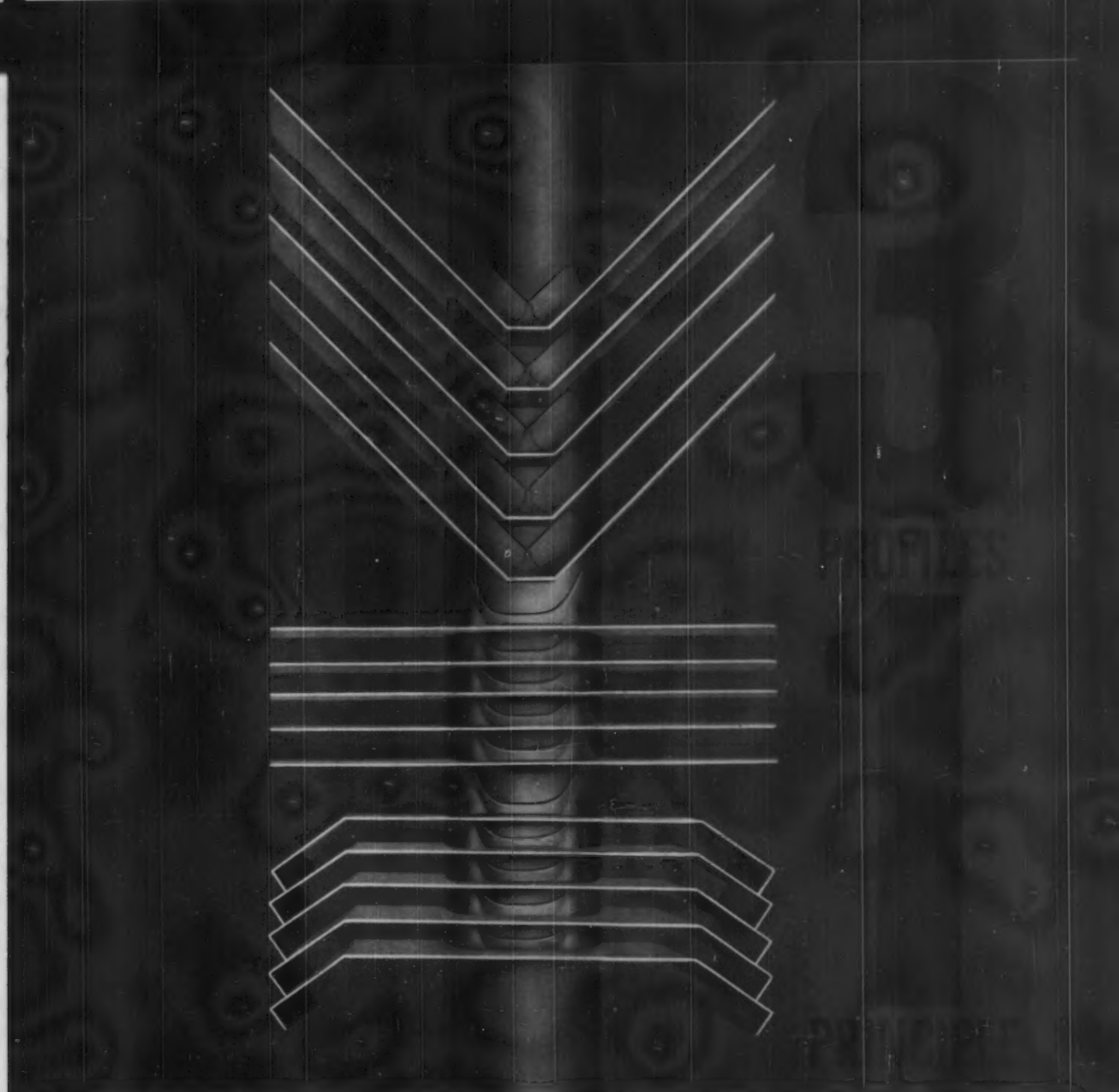
ucts, illustrated with photographs and dimensional diagrams. Installation instructions also included. *Marman Div., Aeroquip Corp., Dept. HPAC,* 11214 *Exposition Blvd., Los Angeles.*

▸ *COAL FIRED GENERATORS*—Operation, advantages, performance of bituminous coal fired water tube package generators outlined in new bulletin "1100." Manufacturer's types "PSL," and "PSH" described in detail, illustrated with photos, cutaway drawings. Performance curves of both models given in chart form; capacities, ratings, specifications also included. *International Boiler Works Co., Dept. HPAC,* 5 *Birch St., East Stroudsburg, Pa.*

▸ *COMBINATION BURNERS*—New, 8 page bulletin describes line of gas, oil combination "Hydro" burners. Operation, economy, installation outlined in text. Results of product test made by engineering department of University of Utah included. Bulletin illustrated with photos, diagrams, cutaway drawings. *Utah Hydro Corp., Dept. HPAC,* 315 *Ness Bldg., Salt Lake City.*

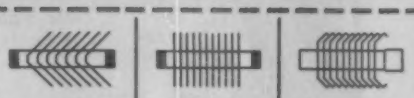
▸ *CONDENSATE PURIFICATION*—Technical reprint "T-157" entitled "Breakthrough in Condensate Purification" discusses use of new principle of internal self-purification in subcritical as well as supercritical operations. Purification accomplished by scavenger demineralizer system within boiler-turbine cycle. Paper is illustrated with diagrams, drawings, charts. *Graver Water Conditioning Co., Dept. HPAC,* 216 *W. 14th St., New York* 11.

▸ *COOLING EQUIPMENT*—New catalog covers company's complete line of air conditioning and refrigeration equipment parts, supplies. The 154 page catalog contains illustrations, complete specification for ordering by mail. Catalog is indexed.



THE PROFILES: ■ THE V-SHAPE; Slant/Fin's patented processes* make possible the use of stainless steel and other heavy metal fins with full weight and extra heavy pipe. ■ THE "SQ" SERIES; Even conventional square finned elements include a Slant/Fin extra. Unique tooth-and-bubble construction, assures positive alignment and stronger thermal bond. ■ THE MODIFIED-V; Fin-touch-fin construction permits use of light gauge fin material while maintaining maximum mechanical strength. And it's also the first element in heating history free of fin vibration noise! **THE PRINCIPLE:** Every Slant/Fin product is design-engineered to fully exploit the structural and physical properties of the materials used... to measure up to the most demanding specifications in the industry. **THE PARTICULARS:** Learn how you can specify a product of uncompromising quality at a price that's competitive with any in the industry. Fill in and mail this coupon... in return receive the 1958 Slant/Fin Catalog of Commercial and Residential Heating. It tells all.

*PATENT NO. 2620171 AND OTHER PATENTS PENDING.



Please see that I receive your 1958 Catalog
I am a
☐ Contractor ☐ Builder ☐ Architect
☐ Heating Engineer ☐ Wholesaler ☐ Other

Name_____

Firm_____

Address_____

City_____ State_____

Slant/Fin

SLANT/FIN RADIATOR CORP.
87-49F 130th Street, Richmond Hill 18, N. Y.

SEE THE SLANT/FIN EXHIBIT AT BOOTHS 401—403 O.H.I. EXPOSITION, NEW YORK COLISEUM, JUNE 9—12

Smog proves recirculation pays

Smog is no problem at St. Vincent's Hospital, Los Angeles: activated charcoal purifies inside air for recirculation. Air conditioning and ventilating loads are reduced at substantial savings. Inside air is always "fresh" and odor-free, regardless of outside air contamination.

Whatever your air conditioning requirements, it will pay you to evaluate the savings—reduced investment in equipment *and* operating costs—from air purification with activated charcoal.

Write for Bulletin T-318. Barnebey-Cheney, Columbus 19, Ohio.

Barnebey-Cheney PurAir filters are easily installed and replaced as needed. St. Vincent's Hospital has 49 "cells," each handling 1000 cfm.

activated charcoal air purification

Barnebey Cheney

RECENT TRADE LITERATURE

Continued

Henry M. Sweeny Co., Inc., Dept. HPAC, 517 Fourth St., N. W., Washington, D. C.

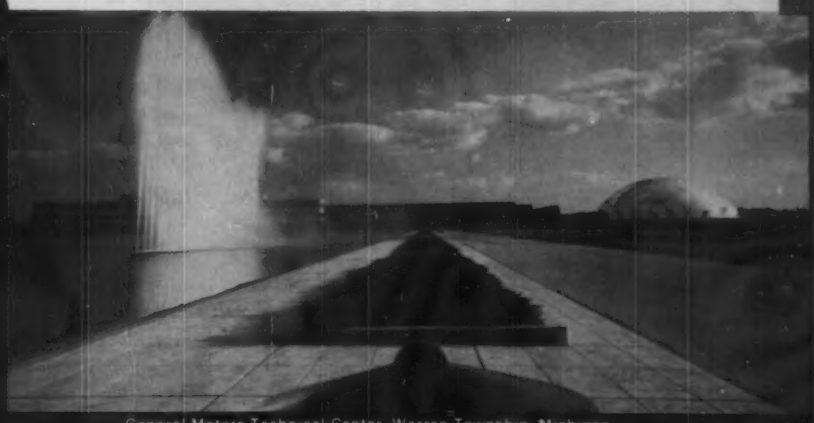
▸ *COOLING TOWERS*—Company's line of cooling towers is described in bulletin "4.9080A" Company's research, unit components, specifications, typical installations all given in illustrated bulletin. Diagrams, tables, cutaway drawings also included. *J. F. Pritchard & Co. of California, Dept. HPAC, 4625 Roanoke Parkway, Kansas City 12, Mo.*

▸ *DEMINERALIZERS*—Principles, method of water demineralization by ion exchange given in bulletin "WC-111A." Advantages, applications of water demineralization method shown. Publication shows manufacturer's line of demineralizers and accessories with charts, diagrams, specifications for each. *Graver Water Conditioning Co., Dept. HPAC, 216 W. 14th St., New York 11.*

▸ *DIFFUSERS, REGISTERS*—Product selector chart and engineering data sheet offered. Diffusers, registers, grilles for floor, baseboard, wall, ceiling applications illustrated, identified in selector-chart. Engineering data sheet under calendar pad has charts, tables giving recommended delivery velocities, Btu to cfm conversions, sizing of round pipe, extended plenums with list price, free areas for all company's products. Air capacities in cfm given for "Lima Flexi-Trol" air conditioning grilles, registers in air velocities 250 to 1250 fpm. *Lima Register Co., Dept. HPAC, 1790 N. Cable Rd., Lima, Ohio.*

▸ *DISC THERMOSTAT*—New technical data bulletin "THSN-21" gives revised data on manufacturer's recently developed air conditioning thermostat "Klixon 20220." One application recommended by company

COUNT ON WATTS FOR PROTECTION WHERE IT COUNTS



General Motors Technical Center, Warren Township, Michigan

Prudential Life Insurance Company Building, Chicago, Illinois

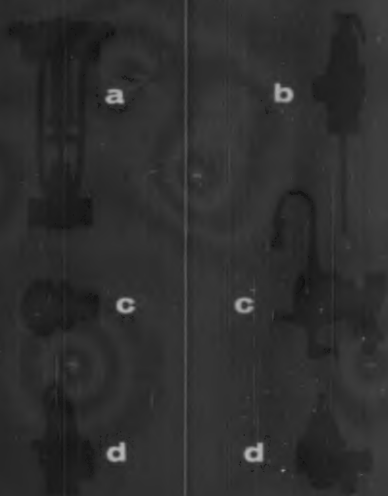
Skyscrapers and schools —
have this in common —
they both demand maximum security
in protection and control.

Trouble-free, automatic regulation and protection of such services as hot water supply, water for drinking and sanitary purposes, steam and hot water heating equipment, call for dependable protection and control devices.

The top-level standards of protection and control of these and other prominent buildings are maintained by WATTS products.

We invite your inquiry —
technical or commercial.

Our complete catalog is yours
for the asking.



WATTS

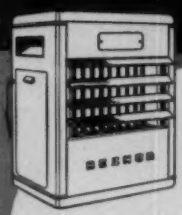
REGULATOR COMPANY

Lawrence, Massachusetts

a Steam, Water, Air Pressure Regulators
b Temperature, Pressure ASME Relief Valves
c Boiler Water Level Controls
d Hot Water Heating Specialties

modern heating for business and industry...

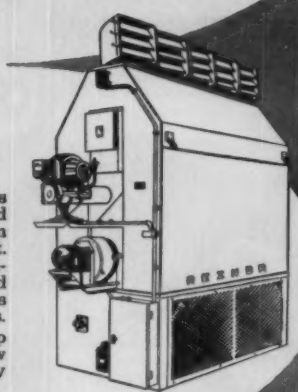
REZNOR UNIT HEATERS



SUSPENDED TYPE

Gas-fired—for use with natural, manufactured, mixed or LP gases. Eleven sizes: 25,000 to 300,000 Btu input. All sizes available with choice of propeller fan or centrifugal blower for air movement. FlexiTemp control system, featuring automatic two-speed fan operation, optional on propeller fan models up to 100,000 Btu. Aluminized steel construction standard, stainless steel optional at extra cost. These heaters are self-contained, completely automatic units for the production and distribution of heat at the point of need. Installation involves only suspension, utility connections and venting. Practically no maintenance required.

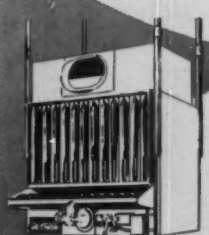
Floor-mounted models for use in offices and similar areas available in 25, 50, 65, and 75 thousand Btu sizes.



FREE-STANDING TYPE

These stainless steel direct-fired heaters are designed for large industrial and commercial space heating jobs. Ten sizes, 400,000 to 2,000,000 Btu input. Heaters can be equipped with gas burners (for natural, mixed, manufactured or LP gases), oil burners (for fuel oils through #5 grade) or dual-fuel burners.

Heaters may be floor-mounted for top discharge or suspended for down-flow or horizontal discharge. They are easily adapted for use in duct systems.



DUCT TYPE

Reznor duct heaters are compact, highly efficient gas-fired heat exchangers with a full complement of operating controls. They are designed for assembly in custom engineered duct systems with components for air moving, cooling and filtering specified to meet exact job requirements.

Series DS sectional duct furnaces (shown) are available in 4 sizes . . . 150, 200, 250, and 300 thousand Btu. Systems with capacities in excess of 2,500,000 Btu can easily be assembled using these four basic units. Aluminized or stainless steel construction. Accessory blowers available to meet most air delivery requirements.

there is no equivalent for Reznor unit heaters

for complete details, wherever you are . . .

Look for Reznor under "Heaters-Unit" in the Yellow Pages

REZNOR
WORLD'S LARGEST SELLING DIRECT FIRED
UNIT HEATERS

Reznor Manufacturing Company
51 Union Street, Mercer, Pa.

RECENT TRADE LITERATURE

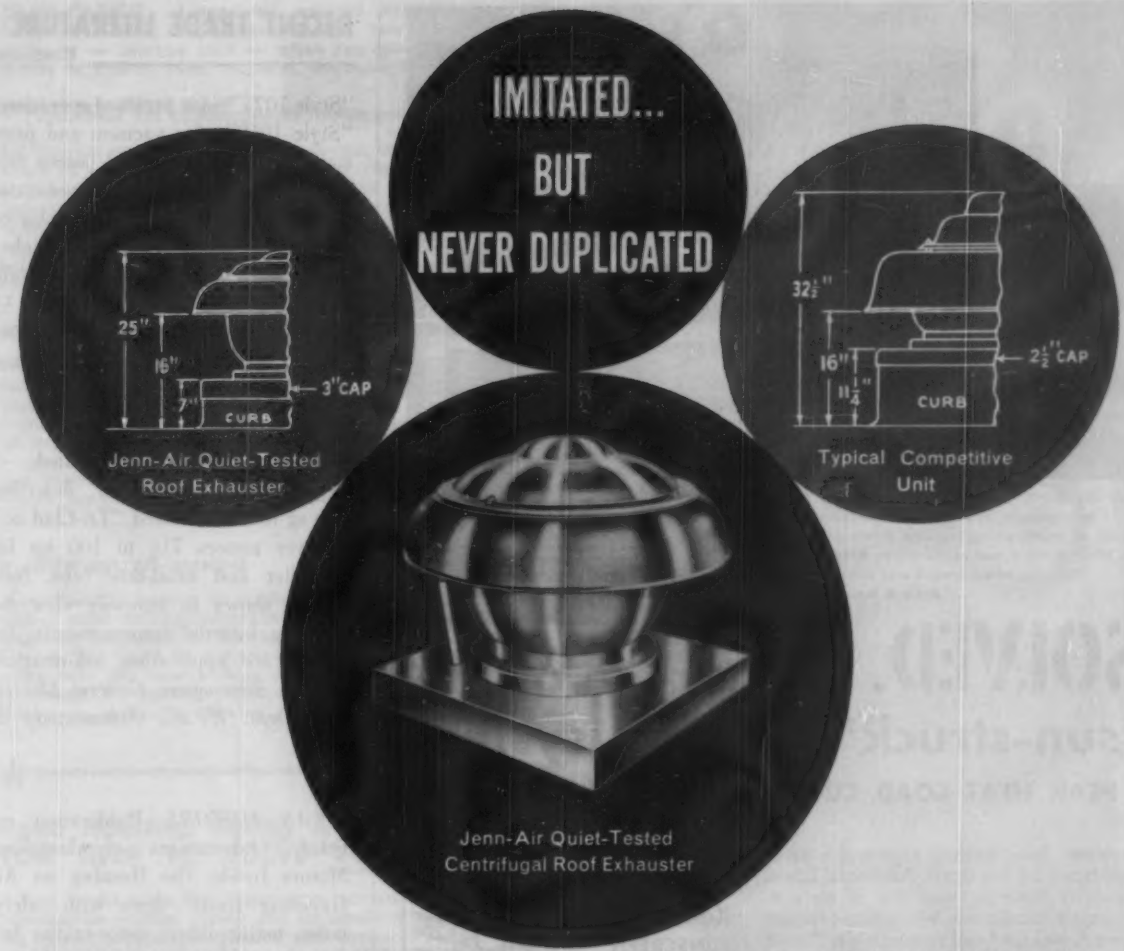
Continued

is in prevention of freezeup in air conditioning units, accomplished by controlling compressor directly when frost forms on evaporator or coils, allowing reduction of component parts dimensions resulting in smaller unit size; also deals with problem of evaporator freezeup when compressor capacity is increased. Publication shows configurations, dimensions, revised temperature settings, electrical ratings. *Metals & Controls Corp., Spencer Thermostat Div., Dept. HPAC, 34 Forest St., Attleboro, Mass.*

▸ *DUCT ACCESS DOORS*—Recently issued catalog describes manufacturer's line of latches, hinges, gaskets for sheet metal industry. "Ventlok" access door hardware, access doors, damper hardware presented, illustrated. Company also manufactures complete line of fabrics for flexible connections in sheet metal ducts. *Ventfabrics, Inc., Dept. 17-HPAC, 640 N. Kedzie Ave., Chicago 12.*

▸ *ELECTRIC MOTORS*—New 12 page 1958 motor application guide "Form 270" details operation of matching motor characteristics and load requirements. Application chart gives information on typical driven equipment, character of loads, starting and running torques. Factors matched to motor designs, company's motor types and descriptions, starting currents, speed ranges, hp ranges, available enclosures. Guide also gives details on line of polyphase, single phase and direct current motors 1/20 to 400 hp. *Century Electric Co., Dept. HPAC, 18th and Pine Sts., St. Louis 3.*

▸ *EXPANSION JOINTS AND FLEXIBLE PIPE*—Catalog "575" gives information on company's new line of rubber expansion joints and flexible pipe in 6 pages. Joints and pipe available in three styles: "Style 1000"—for vacuum operation;



ONLY JENN-AIR EXHAUSTERS OFFER TRUE LOW CONTOUR

The Big Difference is in the Installed Height

To conform with modern construction, low contour in exhausters is the accepted design among architects, engineers and building owners. And Jenn-Air, first to develop low contour spun aluminum exhausters, still engineers the lowest contour of all. Only true measurement of exhauster height is the distance from the roof level to the top of the exhauster. Jenn-Air Quiet-Tested units, when installed, stand 25 to 50% lower than others—yet meet specifications for a discharge height at least 16" above roof level. This is achieved by Jenn-Air's exclusive method of nesting the motor below the discharge of the exhauster. Thus, the base of the exhauster itself supplies the additional height. In competitive models, with a discharge height of only 9½", the curb base must be extended higher to attain the 16" position. Result: overall, installed height of competitive so-called "low contour" exhausters runs 8" to 10" more than that of Jenn-Air. Have a Jenn-Air representative show you the "yard-stick test" . . . proof positive that only Jenn-Air Quiet-Tested exhausters offer *true* low contour.

JENN-AIR PRODUCTS COMPANY, INC.
1102 Stadium Drive, Indianapolis 7, Indiana

At the North American Life & Casualty Co., Minneapolis, Minn., KoolShade Sunscreen solves air conditioning problem shown at right: When Area A was comfortable, Area B was too cold; when Area B was comfortable, Area A was too hot.

SOLVED... the case of the "sun-struck" cooling system

PEAK HEAT LOAD CUT 91 TONS BY KOOLSHADE

Problem: Diagrammed above, the problem faced by the North American Life & *Casualty Building was one of air conditioning* imbalance. When sun-exposed Area A was cool and comfortable, Area B was invariably too chilly. On raising the thermostat, Area B became comfortable ... but Area A would then swelter. Complaints abounded. And excess thermostat-activity was keeping the cooling unit in almost continuous operation.

Solution: KoolShade Sunscreen was installed on the sun-exposed windows.

Results: By screening out the sun's hot rays, KoolShade banished the solar heat from Area A ... thus permitting floor-wide uniformity of cooling. At the same time, KoolShade reduced by some 91 tons the peak load demand on the cooling unit itself. Running time was reduced ... with a substantial savings in operating costs! In addition, office-workers reported marked relief from eye-straining solar glare. And company officials were delighted with the improved appearance of the building.

● **Unmatched shading efficiency.** Operating like a miniature venetian blind installed outside your window, KoolShade's tiny tilted louvres (see cross section at right) screen out up to 89% of the sun's hottest rays.

● **83% clear visibility.** KoolShade admits maximum glareless light ● **Harmony with all architecture** ● **Virtually no maintenance.**

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"Style 1025"—for pressure operation; "Style 1050"—for vacuum and pressure operation. Standard pieces recommended for working temperatures to 180 F and pressures to 150 psig or 30 in. Hg. vacuum service. Higher temperature and pressure units available. Expansion joints available ½ to 72 in. diam. *General Rubber Corp., Dept. HPAC, Summit and Atwood Sts., Tenafly, N. J.*

▸ *FAN MOTORS*—Illustrated, 4 page bulletin "GEA-6598" describes line of totally enclosed "Tri-Clad 55" air-over motors 7½ to 100 hp for propeller and axial-flow fans. New motors shown in cutaway view describing internal improvements. Included are application information, ratings, dimensions. *General Electric Co., Dept. HPAC, Schenectady 5, N. Y.*

▸ *FAN MOTORS*—Publication entitled "Advantages of Installing Motors Inside The Housing on Air *Handling Units" deals with safety,* noise, maintenance, space-saving factors of inside motor mounting. Bulletin intended for those who design, specify, install, service air conditioning systems. *Drayer-Hanson, Div. of National-U. S. Radiator Corp., Dept. HPAC,* 3301 *Medford St., Los Angeles* 63.

▸ *FILTER BANK*—Bulletin tells of new "Seal Tight" filter frame in filter bank assembly. PVC gasket used as seal between air filters and frame Description, specifications, illustrations of assembly given in bulletin. Dimensions of six sizes given. *George Evans Corp., Dept. HPAC, Moline, Ill.*

▸ *FLEXIBLE CONNECTORS*—Recently released bulletin provides specifications, prices on company's line of bronze flexible connectors, designed to convey gases or fluids at temperatures to 400 F. Leakproof and corrosion resistant, says manu-

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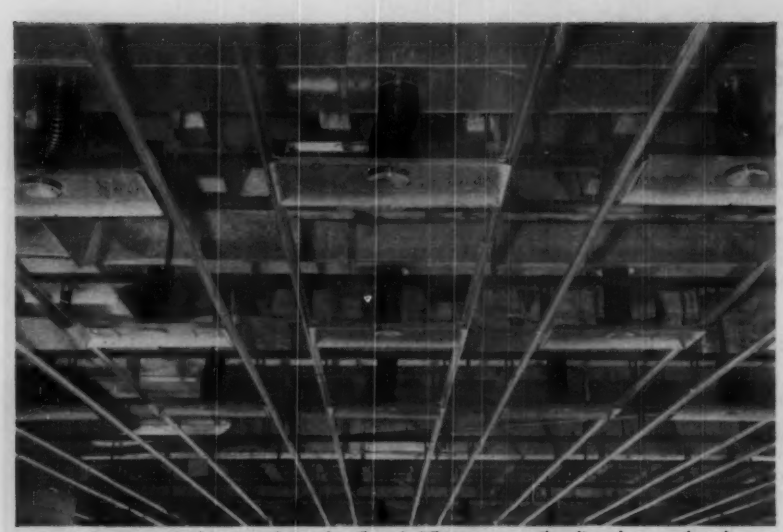

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facturer. Outer cover is braided to provide strength. Flanged, solid male and female union connections available ¼ to 4 in. diam. *Universal Metal Hose Co., Dept. HPAC,* 2133 *S. Kedzie Ave., Chicago* 23.

▸ *FLEXIBLE TUBING*—Technical data book of 36 pages covers types of flexible tubing and hose, with many types of couplings used with tubing. Applications, tests for tubing included. Types, sizes of flexible tubing, expansion joints, suction hose, unloading hose, tar and asphalt interlocked tubing discussed with complete specifications. Corrugated type of flexible tubing, including vibration absorbers and flexible connectors, and large tube for conveying and small tubing for instruments also discussed. *Pennsylvania Flexible Metallic Tubing Co., Dept.* 100-*HPAC,* 7200 *Powers Lane, Philadelphia* 42.

▸ *GAS MANIFOLDS*—Catalog "829" presents company's complete line of gas manifolds. Publication, entitled "Manifolds for Gases," gives information on cylinder capacity, cylinder arrangements and dimensions along with general information on advantages of manifolding. New "8290-5100 Deluxe Stationary Duplex Oxygen Manifold" introduced in catalog. Illustrated with photos, diagrams. *Air Reduction Sales Co., Div. of Air Reduction Co., Inc., Dept. HPAC,* 150 *E.* 42*nd St., New York* 17.

▸ *HEAT, NOISE CONTROL*—Illustrated, 31 page publication, "Fiberglas Materials for Heat and Noise Control," available to product designers. Booklet describes use of glass fiber materials in air conditioning and heating fields as reinforcement for plastic and coated and laminated products. Graphs, tables also included. *Owens-Corning Fiberglas Corp., Dept. HPAC, National Bank Bldg., Toledo* 1, *Ohio.*

RECENT TRADE LITERATURE

Continued

▸ *HEAT PUMPS*—Booklet covers details of results of tests of company's heat pumps at industrial experiment station of University of Florida. Object, procedure and results of tests outlined completely in text, illustrated with diagrams, graphs. Tables supplied, summarizing matter presented. *McMillan Comfortaire Inc., Dept. HPAC, P. O. Box* 5897, 1501 *Miami Rd., Jacksonville* 7, *Fla.*

▸ *IMMERSIBLE MOTOR*—Illustrated, 4 page bulletin "2300" tells of new "Immersible Motor" designed for submerged operation. Bulletin describes applications in which motor is close-coupled to pumps, agitators, mixers, eliminating lengthly shaft connections, intermediate bearings, couplings, special bases. Illustrations, cutaway drawings show engineering features which adapt motor to operation in water, chemicals, abrasive industrial oils, sewage sumps. Full specifications listed for motor, manufactured in ratings ¾ to 40 hp polyphase, ¾ to 5 hp single phase. *Louis Allis Co., Dept. HPAC,* 427 *E. Stewart St., Milwaukee* 1.

▸ *INSULATION ADHESIVES*—Bulletin gives information on insulation adhesives for air conditioning ducts, heating, pipes. Data is given on "SC 4815" for sealing ducts, "SC 4847" for sealing laps and other of manufacturer's adhesives formulated for use in bonding insulation. *St. Clair Rubber Co., Dept. HPAC,* 440 *E. Jefferson, Detroit* 26.

▸ *JET PUMP MOTORS*—"GEA-5920," a 6 page, illustrated publication, discusses fractional hp pump motors for all jet pump installations. Motors may be used in vertical or horizontal positions, are said to be 33 percent lighter than previous designs. Publication contains cutaway drawings of new ventilating system insulation, windings, identifies internal parts and construction of pump motor. Bulletin contains

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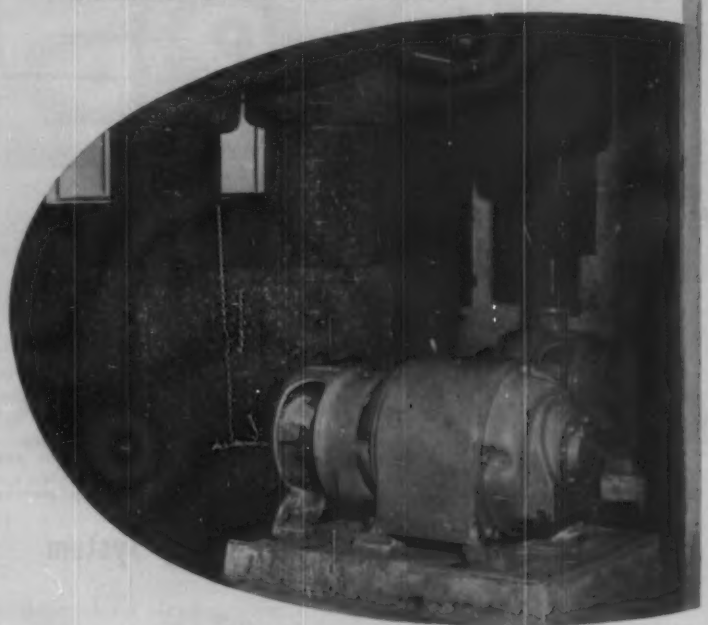

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NEMA mounting, shaft dimensions, ratings, motor sizes, of units. *General Electric Co., Dept. HPAC, Schenectady* 5.

▸ *METAL PUNCHES*—Company's "No. 16" and "No. 17" bench hand metal punches covered in two recently released folders. Dimensions, prices, accessory equipment (including irregular shaped punches, dies) given. Punch capacities for "No. 16": ⅜ in. hole through ¼ in. mild steel; "No. 17": ¼ in. hole through ¼ in. mild steel. *Whitney Metal Tool Co., Dept. HPAC,* 110-114 *Forbes St., Rockford, Ill.*

▸ *MOTOR PROTECTORS*—Illustrated, 4 page bulletin "PR-1243" describes company's line of "Klixon" three phase motor protectors, answers 15 questions regarding application, function, effective range, other aspects of built-in protectors. *Metals & Controls Corp., Spencer Thermostat Div., Dept. HPAC,* 34 *Forest St., Attleboro, Mass.*

▸ *PACKAGE LIQUID COOLER*—Company's complete line of packaged liquid coolers described in new bulletin "HB-258" giving design features, typical installations, detailed description of components. Available from 7½ to 150 tons, cooler may be purchased as unit or in separate parts. All components, including compressor and compressor-motor, built by manufacturer. *Bell & Gossett Co., Dept. HPAC,* 8200 *N. Austin Ave., Morton Grove, Ill.*

▸ *PIPE CONNECTIONS*—New, 12 page bulletin covers pipe connections, unions, vessel closures, bleeder valves. Methods of construction, specifications, prices, features, effective January 1 all given. Company's pipe connections said to be applicable for pressures up to 15,000 psi. *Gray Tool Co., Dept. HPAC, P. O. Box* 2291, *Houston, Tex.*

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▸ *PLASTIC SHEETS, TUBING*—1958 catalog of plastic materials for industry gives current specifications, prices on most plastics in production. Sheets, rods, film, tubing, specialized plastics covered. Technical information, properties, descriptions of various types of plastics provide check on suitability of material to use. *Delta Products, Dept. HPAC,* 1400 *Henderson, P. O. Box* 1440, *Fort Worth* 1.

▸ *PNEUMATIC TRANSMISSION LINES*—Company's "Armortube Cable," flexible, armored, multiple-tube transmission line for pneumatic and hydraulic metering and control systems described in new, 4 page product specification "G91-9" Tables give sizes, shipping weights, tubing and protecting materials, dimensions, installation information. *Bailey Meter Co., Dept. HPAC,* 1050 *Ivanhoe Rd., Cleveland* 10.

▸ *PORTABLE WELDER*—Features, applications of company's "Weldanpower" portable welder outlined in new, illustrated bulletin. Complete tables of specifications, ratings given. Suggested applications, including field erection of structural steel, piping, construction, etc., illustrated with drawings, photos. *Lincoln Electric Co., Dept. HPAC,* 22801 *St. Clair Ave., Cleveland* 17.

▸ *PRESSURE REGULATORS*—Bulletin "401" entitled "Pressure Regulators . . . and How to Select Them" details important considerations for correct application of self-operating and pilot-type pressure regulators. Included are graphic tables for comparisons of basic regulator characteristics. Bulletin covers back-pressure and relief valves of spring-loaded and weight-loaded types; reducing valves; remote pilot-type and valve-mounted regulators; pump governors; steam-operated, packless, self-contained and differential regulators. *Kieley & Mueller, Inc., Dept. HPAC,* 64 *Genung St., Middletown, N. Y.*

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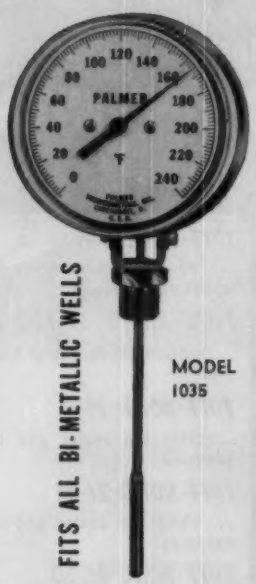

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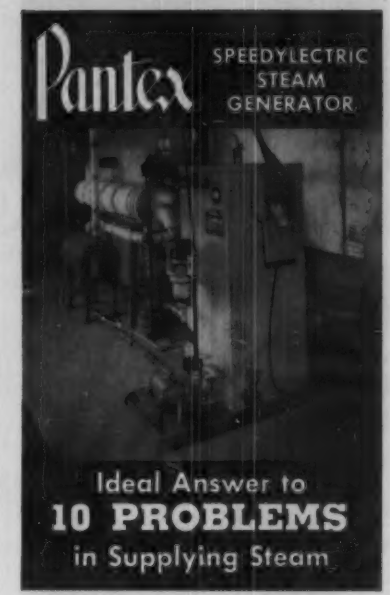
▸ *QUICK-COUPLING*—New 6 page, illustrated bulletin tells of new "Vic-Easy" method of coupling lightweight pipe or tubing. Bulletin details installation, operating features, explains use of lightweight pipe with roll-grooved ends, illustrates typical applications. Bulletin also discusses extended range of new lightweight steel and aluminum pipe, furnished with roll-grooved ends by manufacturer, in diam to ¼ in. Shop type and portable groovers, along with fittings and adapters for grooved end pipe installations also described. Diagrammed and illustrated. *Victaulic Co. of America, Dept. HPAC, P. O. Box 509, Elizabeth, N. J.*

▸ *REFRIGERANT CONDENSER*—Bulletin "RC-25" describes design, performance features of company's new line of straight-tube refrigerant condensers. "RCF" condensers are constructed, pressure tested, Hartford inspected, stamped to ASME specification. Available in sizes 2 to 200 tons. Offered as original equipment or replacement. *Bell & Gossett Co., Dept. HPAC, 8200 N. Austin Ave., Morton Grove, Ill.*

▸ *REMOTE CONTROLS FOR VALVES*—Illustrated, 4 page bulletin on "Use of Manual Remote Controls for Valves" details advantages, use of flexible shaft, standard rigid reach rod control for valves. Various commercial applications illustrated, including power plants and atomic sodium reactor. *Stow Mfg. Co., Dept. HPAC, 445 State St., Binghamton, N. Y.*

▸ *ROTAMETERS*—"Ar-Met" rotameters, designed for pressures to 5000 psi, flow rate equivalents to 3000 gpm of water, described in bulletin "130." Precision pressure-formed metering tubes, said to be dimensionally reproducible to same degree of accuracy as glass metering tubes, now used in company's meters. Bulletin details constructional informa-



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tion, dimensions, capacities. Guide for selection of transmitting and point-of-measurement extension is included. *Brooks Rotameter Co., Dept. HPAC, P. O. Box 432, Lansdale, Pa.*

▸ *SAFETY-RELIEF VALVES*—Detailed information for selection, sizing of nozzle safety-relief valves contained in specifications catalog. Publication concerns manufacturer's valves applicable to process piping. "Standard" and "BalanSeal Bellows" valves are covered with data section containing sizing factors, formulas, nozzle capacity charts for air, water, gas, steam and dimension and weight tables. *Farris Engineering Corp., Dept. HPAC, 563 Commercial Ave., Palisades Park, N. J.*

▸ *SCOTCH STEEL BOILERS*—Catalog covers line of Scotch type steel boilers. Design, engineering data, other information of interest to architects, and engineers concerned with heating, piping and air conditioning industry included. Photo and scale drawings cover standard and packaged boilers. *Burnham Corp., Steel Boiler Dept., Dept. HPAC, Irvington, N. Y.*

▸ *SELECTIVE SPEED DRIVES*—New 8 page bulletin "11-1, P-1" describes motor speed control with selective speed drives. Descriptions are given of company's types "MGS," "MGM" selective speed drives and types "TH," "TF," "TA," electronic drives and "SM" magnetic amplifier drives. Applications of selective drives also described. *Century Electric Co., Dept. HPAC, 18th and Pine Sts., St. Louis 3.*

▸ *SMOKE DENSITY TRANSMITTER*—With "Bailey Bolometer Transmitter" smoke density measurements electrically transmitted to remote indicators and/or recorders as described, illustrated in new 4 page product specification "E66-1." De-

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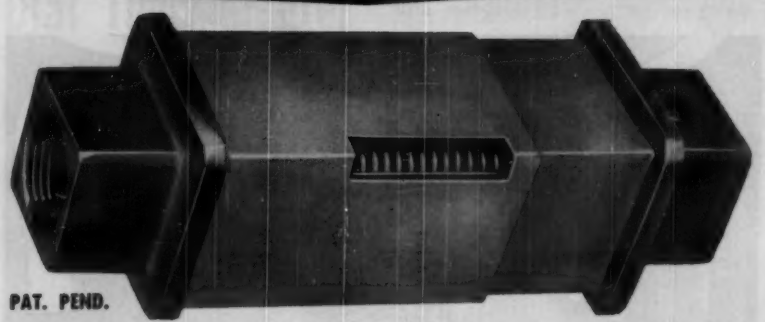

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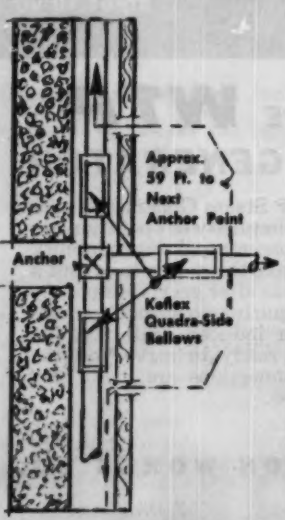

● **ROUND** KEFLEX Bellows are made of Laminated Stainless Steel, multiple ply (usually 2 ply or more) for greater strength with minimum force required to move bellows. The minimum force to move 7 Q Keflex Bellows greatly reduces the need for additional anchoring above that required to handle line pressure thrust force as the force to move Keflex 7 Q only is always less than 100 lbs.

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RECENT TRADE LITERATURE

Continued

tails of radiant energy detection principle of operation provided with installation drawings, wiring diagrams. *Bailey Meter Co., Dept. HPAC,* 1050 *Ivanhoe Rd., Cleveland.*

▶ *SOLENOID VALVES*—New 8 page stock list covers valves available for immediate delivery from company. Contains prices, valve ratings, flow diagrams, illustrations, engineering data, etc. Also has ordering information, selection data. *Automatic Switch Co., Dept. HPAC, Florham Park, N. J.*

▶ *TEMPERATURE CONTROLS*—Nine types of temperature controls described in catalog "MC-156." Included in catalog are "Thermoswitch" units for general industrial use, "Midget" and "Miniature" models for limited space applications, surface mounting and high current capacity designs. "Detect-A-Fire" units for overheat or fire protection, two thermistor controllers and company's new mechanical indicating controller. Temperature and current ratings given for all models. *Fenwal, Inc., Dept. HPAC, Pleasant St., Ashland, Mass.*

▶ *TEMPERATURE INSTRUMENTS*—New, 4 page bulletin covers three new instruments in company's line: temperature controller, solar operated motor, battery powered psychrometer. Bulletin is illustrated, has efficiency diagrams. Dimensions, ranges, specifications given. *E. Vernon Hill & Co., Dept. HPAC, P. O. Box* 189, *Lake Geneva, Wis.*

▶ *UNIT VENTILATOR*—Recently issued, 20 page engineering manual "601-A" gives information on company's "Linoventilator" system of unit ventilators. Description and operation of unit, applications, advantages, components, design procedures, control systems all covered in text

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Model H — vertical unit with discharge heads 12 sizes

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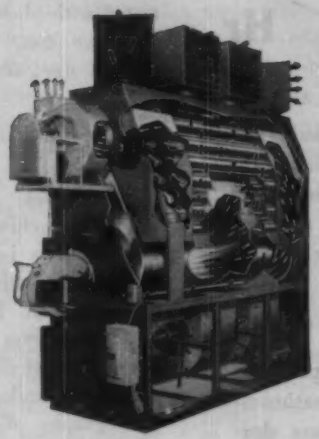
Model C — horizontal ceiling suspension unit for space saving. 12 sizes.



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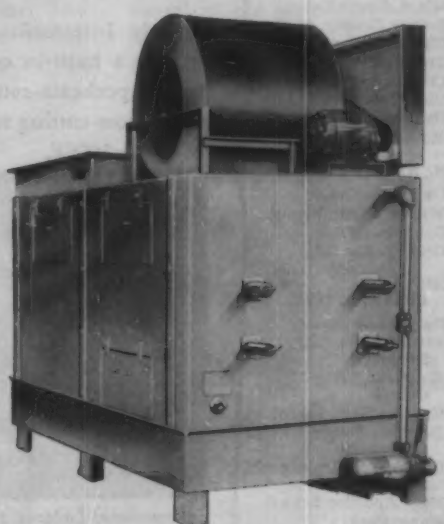

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DIVISION OF NATIONAL-U.S. RADIATOR CORP
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. . . that is the combined total hourly capacity of more than 75 International-LaMont Forced Recirculation Generators throughout the country—and the total is rapidly increasing as new units are placed into operation.

The economies of an HTW system (350°F. to 430°F.) over high pressure steam are significant . . . with International-LaMont Generators the savings are dramatic: 15-18% in installation . . . 15-20% in operation . . . 50-60% in maintenance.

Only International-LaMont Generators feature a built-in counterflow economizer which preheats return water and permits use of cost-cutting temperature differentials of up to 200°F.

International-LaMont Forced Recirculation Generators are available as package units up to 60,000,000 Btu/hr.

The inherent advantages of High Temperature Water for large area district heating systems have been found equally valuable for single building installations. The International-LaMont THERMOJET© series of forced recirculation generators are specifically designed for this type of application. Write today for Bulletins 700 and 1000.

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Steel Firebox Heating & Power Boilers Low & High Pressure Water Tube Package Boilers • International-LaMont Forced Recirculation Generators • ASME Code Pressure Vessels & Welded Products.

RECENT TRADE LITERATURE

Continued

of publication. Ratings, capacities covered in tables. Detailed specifications, dimensions included; illustrated with photos, diagrams. *Vulcan Radiator Co., Dept. HPAC, 775 Capitol Ave., Hartford 6, Conn.*

▸ *VAPOR CONDENSER*—Bulletin "139" describes company's "Niagara Aero" vapor condenser, sectional models. Machine designed to condense vapors in closed system with 7 or 8 deg subcooling, maintaining high vacuum. Functions explained; capacity curves provided for eight sizes; table of dimensions, weights included. Catalog illustrated with photographs, diagrams. *Niagara Blower Co., Dept. HPAC, 405 Lexington Ave., New York 17.*

▸ *WELDING FITTINGS* — Technical data card "FDC-251" furnishes approximate weights of sizes, types of forged steel flanges. "FDC-250" gives weights of eight types of welding fittings in full list of sizes. *Tubular Products Div., Babcock & Wilcox, Dept. HPAC, Beaver Falls, Pa.*

▸ *WELDING FITTINGS*—Bulletin "FB-504" explains method of saving time, money by ordering fittings, flanges produced to close dimensional tolerances. Intended for engineers, purchasing agents, others responsible for procurement of seamless welding fittings and forged steel flanges. *Tubular Products Div., Babcock & Wilcox Co., Welding Fittings Dept., Dept. HPAC, Milwaukee 46.*

▸ *WROUGHT IRON PIPE*—Results of tests on new 4-D wrought iron given in new data sheet. Tests were in areas of atmospheric corrosion, salt water corrosion and acid solution rates. Results show product to be 25 percent more corrosion resistant than regular wrought iron, according to manufacturer. Data sheet is illustrated with graphs. *A. M. Byers Co., Dept. HPAC, Clark Bldg., Pittsburgh 22.*

The Law and Your Profits

(*Continued from page* 109)

did not, as we shall see. Aquaville had failed to issue the bonds and therefore abandoned the project. This left Nehr as a heavy loser and unable to collect a penny.

Nehr sued the city for fees amounting to $361,022, plus interest. His position was: (1) that the agreement provided payment of his fee out of a special fund arising from the sale of revenue bonds and therefore the statute prohibiting municipal corporate liability without prior appropriation would not apply; (2) that when the agreement was signed it was contemplated that any payment under it would not come from the city's general funds, but from special funds; (3) that the making of the agreement did not create the liability for which he was suing; (4) that such liability was later created by the city when it decided to terminate the agreement; and (5) that it was the city, in repealing the bond ordinance, that prevented the special fund from coming into existence.

Judgment in the circuit court was against Nehr. So he appealed. Before the state court of appeals, the defendant city contended that the agreement was null and void for lack of appropriation and that no money belonging to the municipality could be paid on account thereof.

This contention was upheld by the appeals court, which said, "The contract in question is void for want of a prior appropriation," without which "it is impossible for a city to create a liability against itself payable out of its general funds . . . This law is mandatory and was enacted to protect the taxpayer."

Authorities cited by appellant N.G. Nehr were dismissed by the court as "not controlling," and judgment against him was affirmed.

In a petition for rehearing, Nehr protested that the trial court had overlooked "the distinction to be made when"—in this case— "the agreement provides that payment for services rendered thereunder are to be out of a *special* fund and not out of the city's general corporate funds."

After a careful scrutiny of the agreement, the appeals court concluded that, although the engineer was to have been paid out of a special fund derived from the sale of revenue bonds, the contract also obligated the city to pay for part of his services rendered if no special fund had been made available from the sale of such bonds.

Since the agreement obligates the city "to pay for engineering services under certain conditions out of the general fund," that agreement is in violation of law, the appeals court stated. Its original opinion adverse to the engineer and its opinion on rehearing stood as reaffirmed.

Nehr's agreement with the city seemed well enough designed to protect him amply against loss. It was clearly drawn and no doubt reflected the intent and understanding of both parties at the time. Nevertheless, it fell apart because of technical infirmities which might have been avoided by proper legal counsel. ≠

Your ideas work better when you work with HONEYWELL

The following pages bring you the latest developments in automatic controls from Honeywell. They widen your choice of products, give you more to work with.

For complete information on these new control products and systems, call your nearest Honeywell sales office. Honeywell provides 112 offices throughout the country; each is staffed with capable control specialists to assist you in preparing proposals and writing specifications.

Look over these new products and systems. And, remember, they are backed by the kind of support only Honeywell can offer you.

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WHO'S WHAT . . .

(New personnel, promotions)

ALBERT KAHN ASSOCIATED ARCHITECTS AND ENGINEERS—Sol King, president; George H. Miehls, retiring president, presented "Distinguished Alumnus Award" by the College of Engineering faculty of Ohio State University.

WESTCOTT & MAPES, INC.—Carl W. Taylor, executive vice president.

DEVICES INC., DIV. OF MIRACLE ADHESIVES CORP.—Timothy R. Cutler, president.

DE LAVAL STEAM TURBINE CO.—John P. Wooldridge, director; H. G. Bauer, executive vice president; Harry Engvall, vice president of engineering; W. R. Senkus, transferred to headquarters turbine sales department.

CRANE CO.—W. O. Brown, vice president for sales; K. L. Karr, secretary and general counsel; E. E. Wyatt, assistant to the president for administrative planning; Carl R. Canfield, chief engineer, product development department.

THOR POWER TOOL CO.—John A. McGuire, executive vice president; James A. Lind, elected to board of directors.

MUELLER CLIMATROL, DIV. OF WORTHINGTON CORP.—H. P. Mueller, Jr., executive vice president; Frank J. Nunlist, group vice president; Curt Hoerig, vice president—manufacturing; Chester Birch, treasurer; William S. Malloy, secretary; Don Davidson, manager of marketing; Richard B. Schmidt, product sales manager.

TENNEY ENGINEERING, INC.—Saul S. Schiffman, chairman of the board of directors.

BABCOCK & WILCOX CO.—Carl Claus, vice president.

WAGNER ELECTRIC CORP.—G. W. Brown, executive vice president; Paul C. Ford, vice president in charge of engineering and research; R. H. Hackett, vice president, in charge of manufacturing operations.

FLEXONICS CORP.—Howard W. Griesbach, vice president in charge of operations and member of board of directors; Robert M. Burnett, planning coordinator and assistant to the president; Richard S. Ferguson, purchasing agent.

In a restaurant application, the Honeywell "Renew-Air" Filter has high absorption capacity for such objectionable odors as tobacco smoke, burning fat, fish and others likely to be present. In the past, increased outdoor air intake was necessary to diffuse these odors, which resulted in higher air conditioning costs. Now Honeywell's "Renew-Air" Filter removes the odors, enables air conditioning to be operated economically with reduced air intake.

WHO'S WHAT

Continued

W. S. ROCKWELL CO.—Stanley G. Oppenheim, vice president and general manager.

BELL & GOSSETT CO.—S. R. Schleicher, general manager of *MARLOW PUMPS DIV.*

COPELAND REFRIGERATION CORP.—E. Theodore Neubauer, vice president in charge of engineering.

CARLON PRODUCTS CORP.—John I. Rudge, vice president in charge of southeastern district.

MIDCONTINENT TUBE SERVICE, INC.—Harold Michel, vice president of *MIDCO VALVE & FITTINGS, INC.*

A. M. BYERS CO.—Norman J. Johnson, manager of operations.

READING TUBE CORP.—Joseph F. Murray and Alvin Stolinsky, vice presidents.

NICOLET INDUSTRIES, INC.—Thomas E. Hudson, manager of *VALLEY FORGE METALS DIV.*

NATIONAL-U. S. RADIATOR CORP.—L. N. Hunter, senior vice president for engineering and research, elected treasurer of Air-Conditioning and Refrigeration Institute; George O. Gould, director of advertising; Robert S. Hall, assistant director of industrial relations.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS—T. J. Hull, executive secretary; R. W. Huff, Jr., assistant executive secretary.

WEKSLER INSTRUMENTS CORP.—Nicholas C. Munisteri, assistant to the vice president in charge of sales.

CARRIER CORP.—J. F. Downie Smith, vice president—research, honorary member of Iowa Engineering Society.

DRESSER MFG. DIV., DRESSER INDUSTRIES, INC.—Charles G. Thomas, acting manager of purchases.

ROBERTSHAW-FULTON CONTROLS CO.—Charles E. Smith, national service director; D. Rex Scott, manager of planning; Joseph A. McCabe, sales engineer for *BRIDGEPORT THERMOSTAT DIV.*

For your mechanical systems . . .
Honeywell's "Renew-Air" Filters

reduce size of cooling equipment needed, pay for themselves before installation

In restaurants, stores, hotels, office buildings, Honeywell "Renew-Air" Filters can save your clients money. By reducing the amount of outdoor air intake normally required to diffuse internal odors, "Renew-Air" Filters enable you to specify smaller cooling equipment, give your clients efficient air conditioning at a lower initial cost. Savings more than pay for the cost of the Honeywell "Renew-Air" Filters themselves. In addition, client's operating costs are lowered.

And, combined with the Honeywell Electronic Air Cleaner, "Renew-Air" Filters are even more efficient. Their activated charcoal lasts and lasts because no oily smoke or film gets through to clog up the charcoal's pores. There's a bonus with the Honeywell Electronic Air Cleaner, too. It reduces cleaning and decorating costs for owners because it removes dirt particles in the air six times more effectively than ordinary filters.

"Renew-Air" Filters are available in four different sizes and types of cells, easily removable from the frame for re-activation. The Honeywell Electronic Air Cleaner is sold in "building block" modules adaptable to any installation. Call your local Honeywell office for more details.

Honeywell

First in Controls

WHO'S WHAT

Continued

GENERAL ELECTRIC CO.—Charles I. MacGuffie, manager of marketing of the welding department, elected first vice president of the American Welding Society.

HANDY & HARMAN—M. W. Townsend, vice president for administration and finance.

JONES & LAUGHLIN STEEL CORP.—Ben Morell, chairman of the board, presented Washington Award of the Western Society of Engineers.

GARLOCK PACKING CO.—Thomas L. Denney, general sales manager.

FRAM CORP.—James H. Carmine, special consultant in sales, advertising, merchandising, marketing.

BUFFALO FORGE CO.—Theodore M. Dillaway, secretary.

CONTROLS CO. OF AMERICA—Louis Putze, president, elected a director of Young Presidents' Organization; Charles M. Stainton, vice president and director of marketing.

AIRTEMP DIV., CHRYSLER CORP.—Carl E. Buchholzer, president, elected to board of directors of Air-Conditioning and Refrigeration Institute; George H. Childers, special assistant to vice president in charge of sales.

TRION, INC.—John D. Hulser, manager of marketing.

TYPHOON AIR CONDITIONING CO., DIV. OF HUPP CORP.—D. V. Petrone, president, elected president of Air-Conditioning and Refrigeration Institute.

COPELAND REFRIGERATION CORP.—Rudy Berg, vice president, elected vice president of Air-Conditioning and Refrigeration Institute.

SEELYE STEVENSON VALUE & KNECHT—Williams D. Bailey, member of the firm.

SWARTWOUT CO.—G. V. Patterson, general manager of ventilator division.

O. A. SUTTON CORP.—H. F. Hildreth, president and general manager, elected to board of directors of Air-Conditioning and Refrigeration Institute; H. W. Hibshman, vice president, sales and distribution.

For your mechanical systems . . .
New Honeywell Pneumatic Valve and Motor

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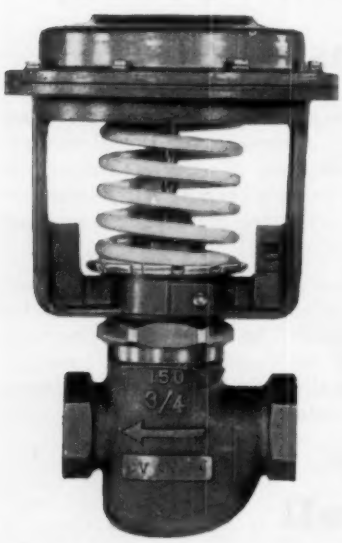
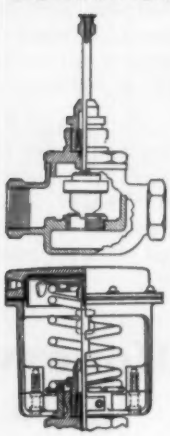


Single seated or three-way valves available in a complete range of sizes. For more information, call your local Honeywell office.

New materials... new designs increase performance for control of steam or water



Valve features! Equal percentage throttling plug plus longer stroke gives better control of steam or water flow at light load.

Exclusive Teflon cone packing lowers friction, lasts longer, requires less lubrication. Easier to change because it comes out with packing nut.

Spring loaded stem and disc holder connection eliminates noise and wear, lasts longer.

Plug type throttling guide eliminates "pocking" of discs due to impingement of fluid through old V Port types.

Packing nut design eliminates periodic tightening, impossible to over- or under-tighten.

Actuator features! Diaphragm design gives more power for smaller diameter. Saves space, positions valve better, gives high close-off ratings. Larger diameter spring eliminates buckling, doesn't rub stem.

Tough Neoprene diaphragm gives longer wear, in normal temperature use. (Silicon available for extremely high temperatures.)

Quick stem-release slide makes actuator easy to remove from valve to change size or to service.

Normally open and normally closed actuators easily interchangeable. Sizes interchangeable, too.

All parts—corrosion resistant.

WHO'S WHAT

Continued

ORR & SEMBOWER, INC.—William B. Myers, correspondent and sales staff member.

OWENS-CORNING FIBERGLAS CORP.—George K. Hammond, supervisor of duct insulation and duct systems sales.

RESEARCH PRODUCTS CORP.—John P. Donnelly, salesman.

YORK DIV., BORG-WARNER CORP.—R. K. Serfass, vice president, elected to board of directors of Air-Conditioning and Refrigeration Institute.

WALWORTH CO.—G. A. Hoffman, assistant vice president.

ALUMINUM CO. OF AMERICA—Gustav O. Hoglund, head of welding section of process development laboratory, elected president of American Welding Society.

WEBSTER ELECTRIC CO.—William J. Wenszell, sales manager of heating div.

CHASE BRASS & COPPER CO.—Charles W. Baker, assistant general sales manger; Allen R. Armstrong, western regional manager, replacing Mr. Baker; Robert H. Chittim, staff manager—tube, replacing Mr. Armstrong.

TRANE CO.—Thomas Hancock, executive vice president, elected to board of directors of Air-Conditioning and Refrigeration Institute; Arthur M. Moody, chief product development engineer; Arne Frank, senior development engineer; Harold W. Murphy, applications engineer.

WRIGHT MFG. CO.—Don A. Elliott, director of advertising and sales promotion.

IN THE TERRITORIES . . .

(Recent sales appointments)

BRYANT MFG. CO.—Robert J. Fairhead, eastern regional sales manager.

JOSEPH T. RYERSON & SON, INC.—Paul J. Fountain, assistant manager of stainless steel sales for Boston steel service plant.

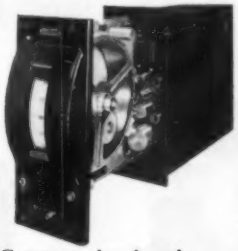
Unlimited remote temperature readings on one Honeywell Electronik* indicator

Scale shown full size. Twin hairline index prevents parallax errors.

With this new, compact indicator, the operating engineer can read temperatures at any point in an air conditioning system simply by pressing a button.

And he gets the most accurate readings known. Honeywell's indicator is accurate to plus or minus 1/5 of a degree because it's electronically precise and its rotating vertical scale—over 28 inches long—gives more than twice the indication area of ordinary circular indicators.

Private offices, zones on each floor, outside air, chilled or hot water lines all can be checked instantly on this one instrument in less than a square foot of panel space. Since sensing elements for the indicator are located right in the thermostat, connected to the indicator by low voltage wiring, there's no need for dual installation.



Compact chassis only 6½" wide. Slides out for inspection without stopping operation of indicator. *Trademark

At little extra cost, a Honeywell Systems Analyzer can be added when desired. Using the same wiring and sensing elements as the indicator, it records, on a 12-inch wide strip chart, the readings for any point or combination of points, provides a permanent record.

Honeywell

First in Controls

WHO'S WHAT

Continued

U. S. GAUGE DIV. OF AMERICAN MACHINE AND METALS, INC.—V. Dallis, branch manager of Atlanta office; F. A. Hebenstreit, sales engineer in Chicago office; G. R. Preisick, sales representative for aircraft sales in New York office.

WORTHINGTON CORP.—R. O. Gundlach, regional sales manager in Midwest with headquarters in Chicago; Deke Jones Co., Detroit, wholesaler of company's products in Michigan; Crest Engineering, Inc., Newark, N. J., sales representative for packaged and central station air conditioning equipment.

SMITH-BLAIR, INC.—Donald F. Deakin, sales engineer in northeastern states.

KRAMER TRENTON CO.—Otto M. Kershock, sales representative in Philadelphia area.

OTM CORP.—New branch office in Denver.

CHASE BRASS & COPPER CO.—Robert Lea, district manager of Grand Rapids, Mich., office; Francis E. Zuber, district manager of Indianapolis office.

TRANE CO.—David Berend, Jr., sales engineer of residential and self-contained air conditioning equipment; R. C. Jones, Jr., Temperature Design Corp., Federal Air Conditioning Corp., Kooleraire Conditioning Co., Inc., Simons Refrigeration Equipment Co., Electr-Ice Maintenance Co., Knickerbocker Refrigeration Corp., Industrial Air Conditioning Co., all of New York City; Conditionaire, Inc., White Plains, N. Y.; E. Robison, Inc., Hartsdale, N. Y.; Air Conditioning Co., Newport, Ky; Hettinger & Shuck, Louisville; Home Maintenance Co., Beatty Engineering Co., Dallas, all authorized sources for company's equipment.

B-I-F INDUSTRIES, INC.—E. R. Clement, Inc., Bridgeport, exclusive Connecticut agent.

POWERS REGULATOR CO.—Donald L. Hinkson, branch manager, Portland, Ore; Evan D. Graham, branch manager, Seattle.

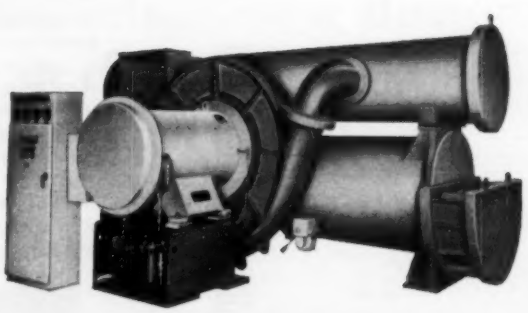
CENTURY ELECTRIC CO.—Baker Terry, St. Louis branch office manager; Ted A. Bender, Seattle branch office manager; Bruce Callahan, San Francisco branch office manager; H. C. Knappenberger, Syracuse branch office manager; R. A. Jervis, Tulsa branch office manager.

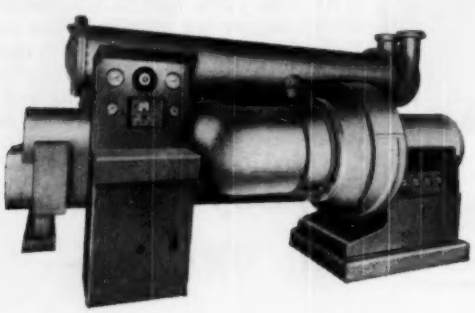
FOR MORE TO WORK WITH ... WORK WITH HONEYWELL

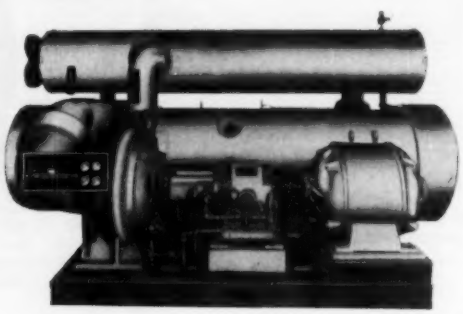
Honeywell Electronic correction of centrifugal

Leading manufacturers use Honeywell controls

Note the free selection of panel location permitted by these Honeywell electronic controls as they are used by leading manufacturers. They hold the chilled water in these machines within plus or minus 1½°—often within plus or minus ½°. The system does not require a wide throttling range, therefore there is little offset from the control point. The motor load limiting system on these controls provides instantaneous correction of vane position.







WHO'S WHAT — *Continued*

GENERAL RUBBER CORP.—Paul-Condit Co., Inc., Houston, representive for eastern Texas, Louisiana, southern Mississippi; Landes, Zachary & Peterson Co. of Texas, El Paso, representative for western Texas, Arizona, New Mexico.

HOOKER ELECTROCHEMICAL CO.—Harry M. Dent Jr., district sales manager for New York state, western Pennsylvania, Ontario, Quebec with company's *DUREZ PLASTICS DIV.*

CHELSEA FAN AND BLOWER CO.—Schooler-Gorman Co., Kansas City, Mo., representative for Kansas, Oklahoma, western Missouri; B. S. Forester, St. Louis, representative for eastern Missouri and southern Illinois; Onarechker & Co., Houston, Texas representative; Pete Bach Electric, Portland, representative for Washington, Oregon, Idaho, Montana.

SLANT FIN RADIATOR CORP.—Ralph R. Bautz, Jr., manager of company's new Norfolk, Va. sales office; Lee Jacobsen, sales representative for central and southern Illinois; R. Wendell Franks, sales representative for state of Indiana.

GUSTIN-BACON MFG. CO.—Lewis Fogg, sales representative in southern California area.

CARRIER CORP.—A. T. Distributors, Memphis distributors of air conditioning and heating equipment.

WOLVERINE TUBE, DIV. OF CALUMET & HECLA, INC.—William N. White, sales representative in greater New York metropolitan area; Neal Hartwell, sales representative in Wisconsin area.

DUNHAM-BUSH, INC.—Clark D. Akers, sales department manager for Marshalltown, Iowa, sales office; Service Parts Co., Melrose Park, Ill., distributors in Chicago area.

ALLIS-CHALMERS MFG. CO.—N. W. Landis, manager of northeast region; Richard L. Engel, manager of industries group Pacific region.

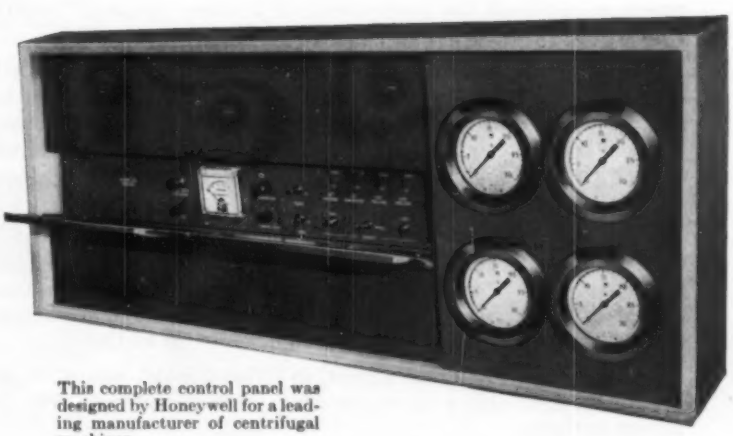
AMERICAN AIR FILTER CO., INC.—Charles Kannapell, salesman in Washington branch office; Collins Hamblen, salesman in New York City branch office; Charles Jacobs, salesman in New York City branch office; Fred M. Erichson, sales representative in New Orleans. ⧺

Controls give accurate sensing, rapid refrigerating machines

This Honeywell Electronic Control System combines the functions of chilled water temperature control and motor load control. Its application to centrifugal refrigeration offers your clients these important advantages:

- Rapid, accurate control of chilled water temperature; instant, positive correction.
- Maximum input current can be set at any predetermined value by a simple adjustment of the load limiting switch.
- The simplest, most trouble-free control of temperature and motor current.
- Consolidates all equipment in one location, permits setup, adjustment and service from the central panel, keeps adjustments secure in a tamper-proof enclosure.
- Permits free selection of panel location —troublesome capillaries are eliminated.

For further information call your nearest Honeywell office. Or write Minneapolis-Honeywell, Department AC-6-103, Minneapolis 8, Minnesota.



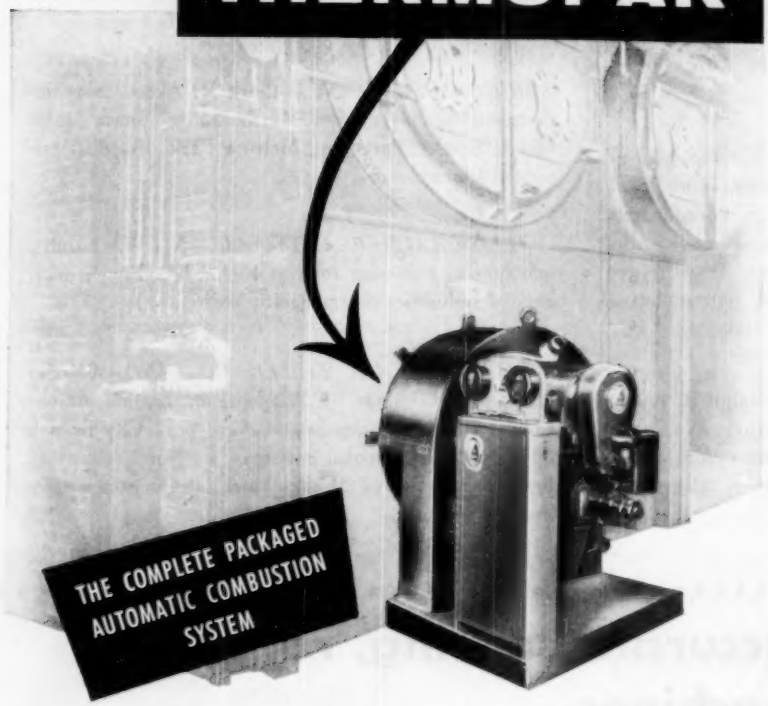
This complete control panel was designed by Honeywell for a leading manufacturer of centrifugal machines.

Honeywell

First in Controls

BRING YOUR BOILERS UP TO PEAK EFFICIENCY *Now*

with **THERMOPAK**



Existing low efficiency, high maintenance boiler plants can be redesigned to approach the performance of modern "package" boilers through the installation of the "Thermopak" system.

The higher heat release of the burner nozzle, coupled with preheated secondary air, will improve combustion efficiencies as much as 20 per cent at all firing rates. This design simplifies internal refractory construction and extends the life of that refractory to 2 to 3 times normal. These advantages in effect assure lower fuel and maintenance costs.

The "Thermopak" costs the least to install: eliminates complicated on-the-job wiring, fuel piping, refractory construction and fitting to the boiler. It is a factory-assembled, fully automatic combustion system for oil, gas or combustion fuels—ready to install in any water-tube, HRT, Scotch Marine or cast iron boiler of 20 to 1000 HP.

Most important—your investment in "Thermopak" means single Preferred responsibility for engineering, erection and instruction in proper operation.

Learn more about the "Thermopak" plan for improving your boilers. Write for Bulletin 185A.

PREFERRED UTILITIES MFG. CORP.
1860 BROADWAY NEW YORK 23, N. Y.

WE HEAR THAT . . .

Three appointments to the Project Consulting Group, a service for architects and engineers, offered by *BUENSOD-STACEY, INC.*, have been announced. *DAVID RICKLETON, N. S. SHATALOFF* and *J. C. ROSE*, company applications engineers, join *JOSEPH W. KREUTTNER*, vice-president of the company, to complete the group.

DAYTON RUBBER CO. has signed an option on a 62 acre site in Springfield, Mo., where it plans to construct a 175,000 sq ft mechanical rubber goods manufacturing plant.

BETZ LABORATORIES, INC. has started construction to more than double present research facilities. The addition will enable the company to step up its studies of corrosion control and scale formation.

The fourth annual series of factory service training schools of *ORR & SEMBOWER, INC.* began on April 28. The schools are for service personnel of representatives handling the firm's automatic boilers.

NATIONAL CYLINDER GAS CO. has changed its name to *CHEMETRON CORP.* The new name became official when stockholders voted the amendment of the certificate of incorporation.

Some 300 to 350 guests attended an open house at the new office and factory of *YOUNG REGULATOR CO.*

KASIMIR OGANOWSKI, associate director of research at *ARMCO STEEL CORP.'s* research laboratories, has received the distinguished service award of the Galvanizer's Committee of the American Zinc Institute.

Aerovent builds 'em BIG!

"WE BUILD THE FANS TO FIT YOUR PLANS!"

Yes . . . in Duct Fans, as in all types of air-moving equipment, Aerovent offers a size for every standard industrial installation (and special applications to order).

Illustrated above is a huge 84" Duct Fan . . . one of 24 built by Aerovent for The Consolidated Edison Company for installation in its Arthur Kill and Astoria Generating Stations. These fans, with 20 H.P. motors turning 580 RPM, move air against resistance at the rate of 100,000 CFM. Other Aerovent units are available in sizes from 12" to 96" for capacities to 145,000 CFM.

Aerovent Duct Fans . . . direct-driven for standard applications or belt-driven for conditions requiring motor outside airstream . . . may be ordered with special duty motors, alloy propellers and special protective coatings for extreme temperature, moisture or corrosive conditions.

WRITE FOR FREE BULLETIN No. 151

DUCT FANS FOR ALL INDUSTRIAL REQUIREMENTS

Direct-Driven Duct
For installations which permit connection of entire fan assembly in air-stream. For vertical or horizontal use. 12" to 96".

Belt-Driven Duct
Used for corrosive or high-temperature conditions, which require motor to be outside airstream. 2, 4, 6 or 7 blades. 12" to 96".

"Bi-Flo" Duct
For pressures in the 1½" to 4½" range. New 7-blade "Mechete" Airfoil Propellers move more air with lower horsepower. 18" to 48".

"EFFICIENCY-ENGINEERED" equipment for every air-handling problem!

Rated in accordance with Standard Test Code and U.S.D.C. Comm. Std. CS178-51.

Aerovent FAN CO., INC.

Ash and Branch Sts — Piqua, Ohio

Available NOW!

INDUSTRIAL VENTILATION MANUAL

- Revised equation for oven ventilation.
- New material on ventilation of radioactive and high-toxicity contaminants.
- 16 new hood designs, 33 revised hood designs.
- New material on air cleaning for radioactive contaminants.
- Revised equation for airflow into hoods.
- Revised table for collectors in industry.
- New chart on comparison of air filter characteristics.
- Revised, up-to-date table of maximum allowable concentrations.
- Revised table of physical constants.

Here's the biggest and most comprehensive Industrial Ventilation Manual yet — over 200 pages, containing more than 200 diagrams, 52 tables of ventilation material and 13 ventilation charts.

The Ventilation Manual contains all the information needed for the complete design of industrial ventilation systems. It is the official publication of the American Conference of Governmental Industrial Hygienists and is used as a basic text by leading universities. The recommended ventilation practices are approved by Federal, State and Municipal Government Industrial Hygiene Departments.

JUST $4 — MAIL COUPON TODAY!

Committee on Industrial Ventilation
P. O. Box 453, Lansing 2, Michigan

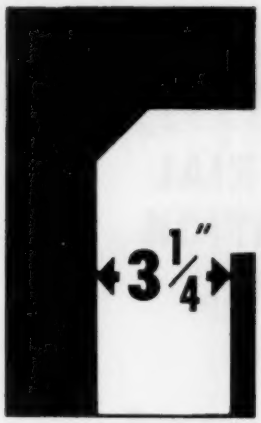
Enclosed please find $_____ for _____ copies of the new 5th edition of the Industrial Ventilation Manual.

Name _____

Firm _____

Address _____

City and State _____



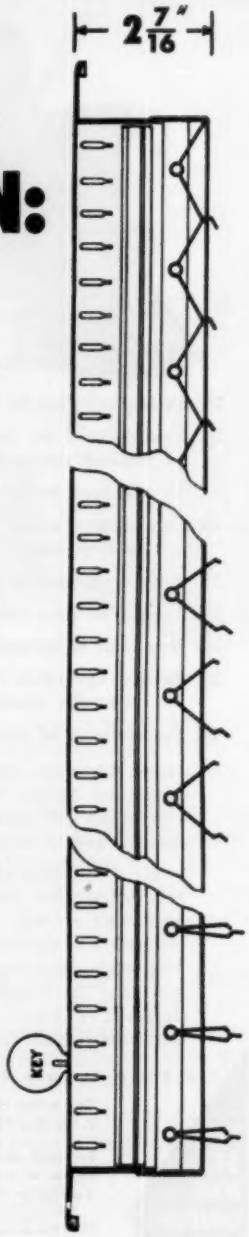
PROBLEM:

To find a commercial-type register with four way air-direction control plus volume control, that will work in standard 3¼" duct.

SOLUTION:

AIR CONTROL'S *Multi-Trol* Registers have exclusive **Shallo-Valve** – fit fine in 3¼" duct, leaving plenty of space for full air volume. And note how this patented butterfly valve action provides positive air volume control – assures even air distribution over register face at any setting. Seals *tight* when closed – can't whistle or rattle.

Ideal for both heating and cooling in commercial and deluxe residential installations, Air Control's *Multi-Trol* registers feature fully adjustable face bars for 2-way or 4-way control of air pattern. Bars have air foil shape and are locked to side margins – can't come loose. Complete range of style and sizes. Attractive beige prime coat.



FREE '58 CATALOG SHOWING COMPLETE AIR CONTROL LINE — SEE YOUR JOBBER OR WRITE US.

AIR CONTROL PRODUCTS, Inc.
358 Center St., Coopersville, Michigan

WE HEAR THAT

Continued

AMERICAN GAS AND ELECTRIC CO. and *AMERICAN GAS AND ELECTRIC SERVICE CORP.* have changed their names to *AMERICAN ELECTRIC POWER CO., INC.* and *AMERICAN ELECTRIC POWER SERVICE CORP.*, respectively.

The construction of a new building by *INTERNATIONAL NICKEL CO.* at its Huntington, W. Va. works has been announced. The addition will increase production capacity for cold drawn seamless tubing products by 50 percent.

UNITED STATES AIR CONDITIONING CORP. has completed its move from Philadelphia to its new location in Delaware, Ohio.

CONSULTING ENGINEERS COUNCIL OF THE UNITED STATES has sent its president, Edward J. Wolff, as its representative to the annual meeting of the *FEDERATION INTERNATIONALE DES INGENIEURS-CONSEILS* at Oslo, Norway.

ARMSTRONG CORK CO.'s GLASS AND CLOSURE DIV. has announced a multimillion dollar expansion project involving four plants at Dunkirk, Ind., Millville, N. J., Lancaster, Pa., and Keyport, N. J. The new program is intended to increase manufacturing and warehousing facilities and improve efficiency in the packaging supply industry.

WATER SERVICE LABORATORIES, INC. has moved its New York office and laboratory to 615 W. 131st St. The new headquarters contains 50 percent more space than the organization's former building.

A new plant addition has been made by *LIMA REGISTER CO.* to increase production and storage space.

J. CRAWFORD DONALDSON, 70, sales engineer in the Chicago branch office of *AMERICAN AIR FILTER CO.* has announced his retirement.

GREGORY INDUSTRIES, INC. has announced the acquisition of *J. D. POLIS MFG. CO.*, Chicago.

The name of *TRUCO WATER SWIVEL DIV., WHEEL TRUEING CO.* has been changed to *TRUCO MASONRY DRILLING DIV.* in order to more accurately identify it with its line of equipment for diamond drilling in masonry. ≠

THE NEW MILLER ALL-IN-ONE SPOT WELDER for ALL NUMBER ONE WELDS

LECTRO SPOT

Built-in Timer Turns the Trick

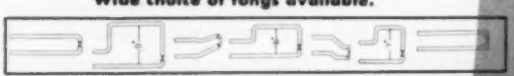
Sheet metal shops ready for new speed, economy and completely uniform spot welds will want the new Lectro Spot. Here's why:

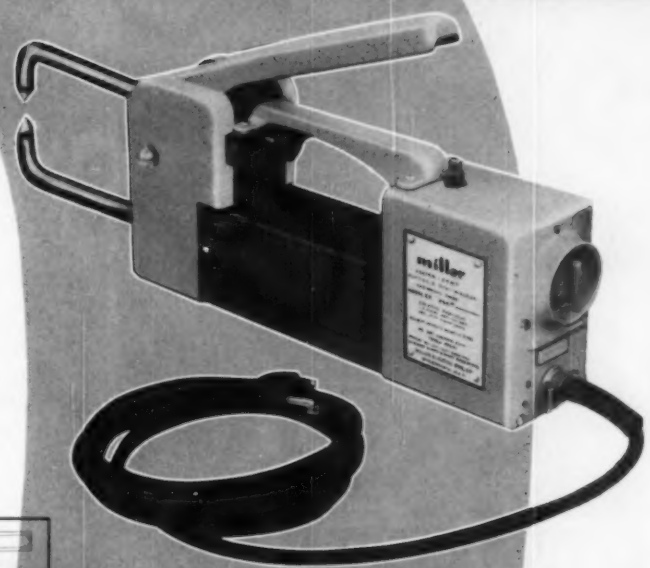
Operator depresses lever and,
1 — 2 — 3:
Tongs grip work at pre-set pressure;
Starter switch is actuated;
Weld sequence starts and stops automatically;
Result: EVERY WELD IS IDENTICAL!

Pressure adjustment and electronic timer controls instantly accessible.

Three models in 115 or 230 volts weld mild steel of 1/8" to 3/16" combined thickness; 1.5 KVA weighs 29 lbs., 2.5 KVA weighs 39 lbs.

Wide choice of tongs available.





Complete information sent promptly.

miller ELECTRIC MANUFACTURING COMPANY, INC. Appleton • Wisconsin

Distributed in Canada by Canadian Liquid Air Co., Ltd., Montreal

SAVE FIVE WAYS WITH FRICK
EVAPORATIVE CONDENSERS

- **WATER**
  Evaporative condensers take advantage of the heat absorbed in the evaporation of water—saving water and power to pump it.
- **LABOR**
  Superior design and better materials (galvanized throughout) make Frick condensers more efficient and easier to maintain.
- **TIME**
  Frick - Mollenberg controls are automatic — save time and keep condenser operating steadily in all kinds of weather.

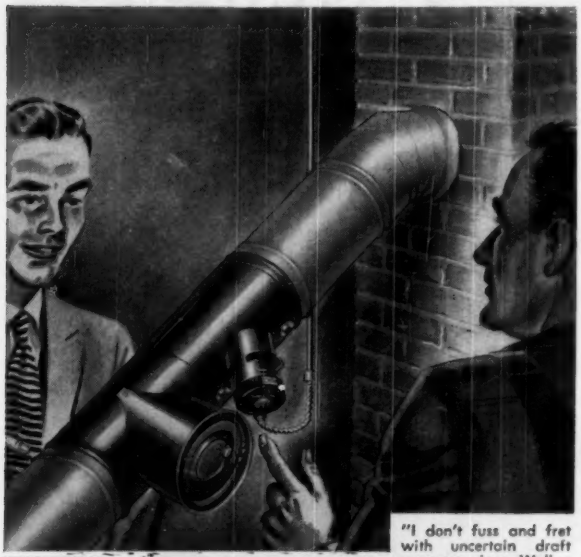
- **POWER**
  Ample cooling surfaces and conservative ratings enable Frick condensers to lower the condenser pressure and temperature and save power.
- **MONEY**
  Reasonably priced and far more durable, they are economical to own and operate. A stock item, they are available for immediate shipment.

Frick Company manufactures a complete line of air conditioning and refrigerating equipment, designed for your individual requirements.

WRITE FOR YOUR FREE COPY OF THE NEW BULLETIN 234 TODAY

DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA., U. S. A.

"Sure! This Walker Unit Ends All My Draft Problems"



"I don't fuss and fret with uncertain draft anymore since Walker brought out this low-priced draft inducer-regulator combination. Now, I install Walker inducers on all my jobs. That puts me way out ahead, because with good draft I know every job will be exactly right from the start.

WALKER
SHUR - FLO
Draft Inducer-Regulator

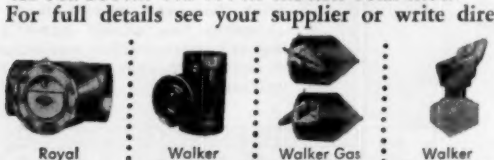
"Most Efficient Draft Control System Ever Made"

Say Heating Contractors, Architects, Builders & Home Owners

Here's an economical answer to every draft problem from older heating installations to modern, low-roofed houses. The new Walker Shur-Flo (Pats Pending) is the surest draft system ever devised – and the most economical. Walker's fan operated draft inducer moves ONLY flue gases ... does not suck in outside air. No wonder it runs quieter, costs less, requires less power. Walker does a complete job of inspirating draft and controlling excess draft. Models available for oil, gas, and coal fired installations.

Perfect for modern homes whose lower chimney heights present a draft problem, the new Walker Shur-Flo is popular with heating contractors and builders because it installs quickly at any angle – vertically, horizontally or at a pitch. Economical in cost, it is highly profitable since it virtually eliminates costly call-backs and corrections. The carefully balanced propeller type fan and small but sturdy motor assure quiet trouble free operation, free from vibration.

SEE OUR BOOTHS 412-414 AT THE NEW YORK SHOW.
For full details see your supplier or write direct.



Royal Purple | Walker Junior Line | Walker Gas Double Swing | Walker Chimney Cap

WALKER MFG. AND SALES CORP.
1720 Penn St., St. Joseph, Mo.

MEETINGS & CONVENTIONS

1958

JUNE 9-13—*Fourth International Automation Exposition and International Automation Congress.* Coliseum, New York. Information: Richard Rimbach Assoc., 845 Ridge Ave., Pittsburgh 12.

JUNE 9-13—*Seminar on Electrical Precipitation Equipment.* Pennsylvania State University. Information: Extension Conference Center, Pennsylvania State University, University Park, Pa.

JUNE 22-27—*American Society for Testing Materials,* 61st annual meeting. Hotels Statler and Sheraton-Plaza, Boston. ASTM headquarters: 1916 Race St., Philadelphia 3.

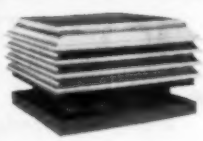
JUNE 23-25—*American Society of Heating and Air-Conditioning Engineers, Inc.* and *American Society of Refrigerating Engineers,* simultaneous meetings. ASHAE meeting at Pick-Nicollet Hotel, Minneapolis. ASHAE headquarters: 63 Worth St., New York 13. ASRE meeting at Hotel Leamington, Minneapolis.

GREENHECK *Air Movement Devices*

"C" Series

1958 "COLUMBUS" CENTRIFUGAL POWER ROOF EXHAUSTER

The clean solid lines of the new COLUMBUS direct drive (range from 75 to 22,000 CFM) centrifugal power roof exhausters are the first indications of the top quality materials and careful workmanship that make up each GREENHECK power ventilator. Non-overloading wheels, rubber vibration mounting, rugged ball bearing motors isolated from the exhausted air stream, and spun aluminum housings for lasting beauty provide top value. The companion BOSTON series belt drive units feature identical housings with an extended range (from 500 CFM to 4300 CFM). Write today for catalog 6-7 which gives complete engineering information.



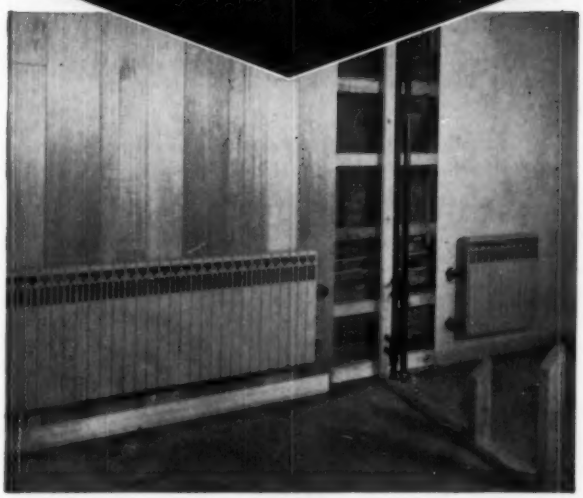
WAUSAU
Air Mover Belt drive centrifugal power roof exhauster. 300 CFM to 27,000 CFM range.

DALLAS
Air Mover Belt drive centrifugal power roof exhauster.

CENTRIFLO
Turbine Ventilator Available in aluminum or galvanized.

GREENHECK
FAN & VENTILATOR CORP.
SCHOFIELD • WISCONSIN

REDUCE piping costs . . . SPEED installation



with

SHAW Radiators

Only Shaw, of all modern radiators, offers *same end* as well as opposite end tapping. Same end tapping has a place in almost every piping layout, and its use invariably means less piping materials, simplified pipe fitting.

Important savings in installation time are made with *any* Shaw model, regardless of tapping arrangement. Shaw units are compact, fully self-contained assemblies only 3" thick, easy to handle and mount. There are no dampers, or separate housings to fit and install.

Shaw Radiators distribute both radiant and convected heat in unvarying, health-guarding proportions that create natural thermal comfort in a room. They use either hot water or steam up to 150 psi. Write today for free literature on both panel and baseboard models.

Shaw Baseboard and Panel Radiators feature heavy gauge steel heating fins and box-type exterior radiant panels snugly fitted around the heavywall copper tubing. Tubing is then expanded slightly by 3750# hydraulic pressure to hold all components as a rigid, self-contained unit. The tight metal-to-metal bond assures rigidity and full heat conduction.

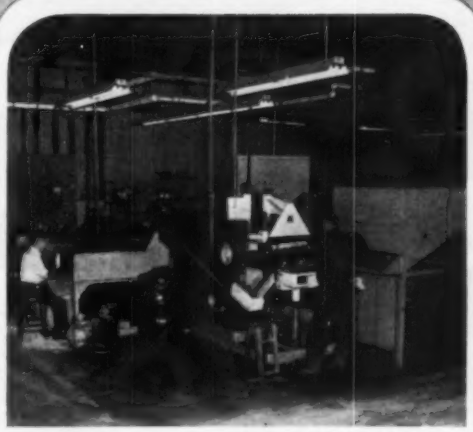
SHAW-PERKINS MANUFACTURING COMPANY
201 East Carson St. • Pittsburgh 19, Pa.

"WITCH"

PIPE HANGERS

FOR

HEATING – PLUMBING POWER & PROCESS



The latest mass-production methods are used to manufacture uniformly high quality pipe hangers and supports at the lowest cost to the customer.

Our catalogue illustrates a *complete* line of Pipe Hangers & Supports and is an indispensable reference book for engineers, contractors, estimators & erectors. Write for your copy now.

MAINTAINING OFFICES AND WAREHOUSES ACROSS THE NATION

CARPENTER and PATERSON, Inc.

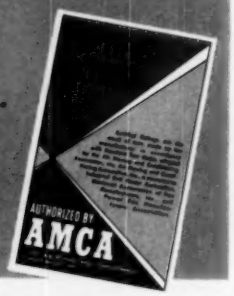
18 HURLEY ST., CAMBRIDGE, MASS.

Type BB Fan

Aladdin
AIR HANDLING EQUIPMENT

For
EFFICIENCY and
QUIET OPERATION...

CERTIFIED
PERFORMANCE



ALADDIN Type BB Fans are the first choice of many engineers for heating, ventilating and air conditioning jobs. Designed for low rotational speeds and high efficiency, these fans insure that stable performance from free delivery to shutoff that engineers have come to expect of this type of equipment.

In designing the BB Fan, Aladdin engineers have refused to short-cut quality, each fan is ruggedly built and is backed by thirty-five years of experience and manufacturing know-how.

Write for complete data

A1

ALADDIN HEATING CORPORATION
1111 WEST AVENUE 137 • SAN LEANDRO, CALIFORNIA

MEETINGS & CONVENTIONS

Continued

1958

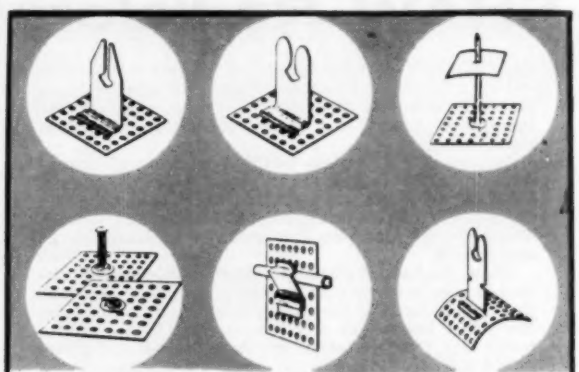
ASRE headquarters: 234 Fifth Ave., New York 1. For further details see page 164.

SEPT. 15-19—*Instrument Society of America*, Instrument-Automation Conference and Exhibit. Philadelphia Convention Hall, Philadelphia. Information: Fred J. Tabery, Exhibit Manager, Instrument-Automation Conference and Exhibit, 3443 S. Hill St., Los Angeles 7.

OCT. 5-8—*National Association of Corrosion Engineers*, technical session. Hotel Somerset, Boston. NACE headquarters: 1061 M & M Bldg., Houston 2.

OCT. 13-15—*National Electronics Conference*, conference and exhibition. Hotel Sherman, Chicago. Information: Rudolph E. Hornacek, publicity committee chairman, c/o Illinois Bell Telephone Co., 208 W. Washington St., Chicago 6.

OCT. 13-15—*American Gas Association*, annual convention. Atlantic City. AGA headquarters: 420 Lexington Ave., New York 17.



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. . . is the secret of Stic-Klips'® success. Designed for attaching insulation strapping, furring, metal lath, wall fixtures, wiring and conduit to nearly all curved or flat surfaces.

Surface punching or drilling is not necessary. There's no fire hazard and you get a strong positive bond. There's a Stic-Klip® for nearly all your fastening requirements.

Send for free illustrated folder.

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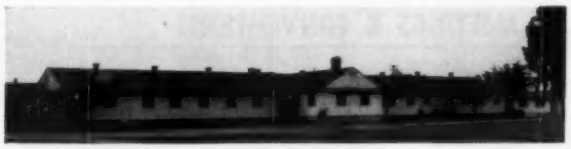
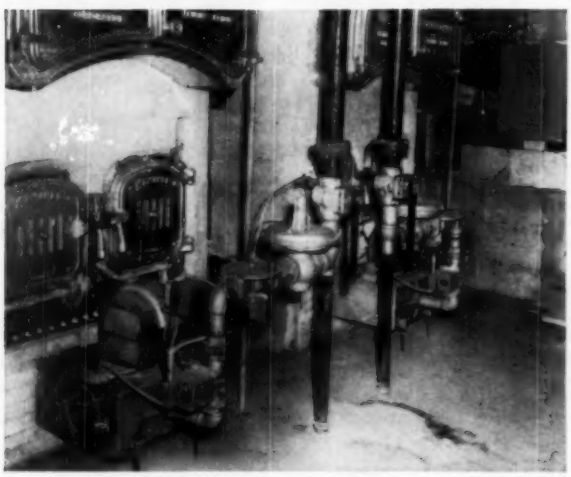
Ask about the time and labor saving 5-Second application method.



WHERE 30,000 CU. FT./HR.
OF GAS ARE BURNED

LO-BLAST

POWER GAS BURNER PAYS OFF!



These Lo-BLAST Burners installed in a mess hall at Fort Devens, Massachusetts, are only two of sixteen Lo-BLASTs installed at this army base. When all are operating, 30,000 cu. ft./hr. of gas are consumed.

The selection of Lo-BLAST Burners was dictated by their outstanding record for safe, consistent performance plus low-cost operation.

These burners use an extremely quiet, low-speed blower to provide perfectly controlled primary and secondary air... operation is always independent of natural draft. They eliminate the need for high chimneys and inshot design reduces maintenance cost. All units are completely assembled and tested on gas before shipment.

Lo-BLAST capacities: 75,000—20,000,000 BTU/hr. input. Send for literature.

Lo-BLAST Economite

This smaller, residential size unit offers the same outstanding economy as larger Lo-BLAST models.

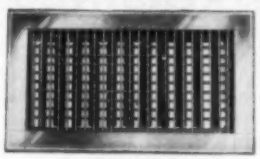
MID-CONTINENT
METAL PRODUCTS CO.
1960 N. Clybourn Ave., Chicago 14, Ill.

...for commercial air conditioning

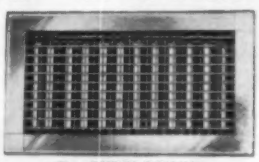
THE IDEAL REGISTERS & GRILLES
For every requirement!

The ease with which any desired airflow, both directionally and volumetrically, can be obtained with these registers and grilles is one reason they have become exceedingly popular. The wide range covered by the quickly obtainable standard sizes is another (380 combinations). Fine appearance, excellent construction and absolutely reliable engineering data are other elements that are making this H&C line first choice of a host of air conditioning dealers for all of their commercial installations. See your H&C Jobber or write for our current Catalog "B".

H&C TRIPL-AIRE® 26 STOCK SIZES PLUS "AS ORDERED"



No. 92VHV DOUBLE DEFLECTION REGISTER



No. 92HVV DOUBLE DEFLECTION REGISTER

No. 92VOV SINGLE DEFLECTION REGISTER

No. 92HOV SINGLE DEFLECTION REGISTER

No. 92HVO DOUBLE DEFLECTION GRILLE

No. 92VHO DOUBLE DEFLECTION GRILLE

No. 92VOO SINGLE DEFLECTION GRILLE

No. 92HOO SINGLE DEFLECTION GRILLE

H&C FIXT-AIRE® 17 STOCK SIZES PLUS "AS ORDERED"

No. 93V RETURN AIR REGISTER

No. 94V RETURN AIR REGISTER

No. 93 RETURN AIR GRILLE

No. 94A RETURN AIR GRILLE

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508 EAST EIGHTH ST. • HOLLAND, MICHIGAN
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- **Hot Water Systems**
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- **Refrigerated Coils**
- **Insulation**
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You can accurately read any low surface temperature with the Alnor Type 2300 Surface Pyrometer—in 3 to 5 seconds.

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MEETINGS & CONVENTIONS *Continued*

1958

OCT. 20-24—*46th National Safety Congress & Exposition,* Chicago. National Safety Council, 425 N. Michigan Ave., Chicago 11.

OCT. 21-23—*National Association of Corrosion Engineers,* South Central Region Conference. Roosevelt Hotel, New Orleans. NACE Headquarters: 1061 M & M Bldg., Houston 2.

OCT. 22-24—*Air-Conditioning and Refrigeration Wholesalers Association,* annual meeting. Sheraton-Palace Hotel, San Francisco. Information: 2607 N. High St., Columbus, Ohio.

NOV. 17-21—*Society of the Plastics Industry, Inc.,* eighth national plastics exposition. International Amphitheater, Chicago. To be held concurrently with the SPI annual national conference, Morrison Hotel, Chicago. SPI headquarters: 250 Park Ave., New York 17.

DEC. 1-5—*American Society of Mechanical Engineers,* National Exposition of Power and Mechanical Engineering. New York Coliseum, New York. Information: International Exposition Co., 480 Lexington Ave., New York 17.

1959

JAN. 26-30—*14th International Heating and Air-Conditioning Exposition.* Philadelphia. Under auspices of the American Society of Heating and Air-Conditioning Engineers, in conjunction with its 65th annual meeting, also in Philadelphia. Exposition management: International Exposition Co., 480 Lexington Ave., New York 17. ASHAE headquarters: 62 Worth St., New York 13.

APRIL 1-3—*Gas Appliance Manufacturers Association,* annual meeting. The Greenbrier, White Sulphur Springs, W. Va. GAMA headquarters: 60 E. 42nd St., New York 17.

APRIL 5-9—*Edison Electric Institute,* annual convention. New Orleans. EEI headquarters: 420 Lexington Ave., New York 17.

MAY 18-22—*National Fire Protection Association,* annual meeting. Hotel Statler, New York. NFPA headquarters: 60 Batterymarch St., Boston. ‡

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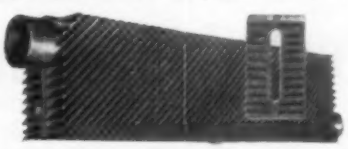
. . . provide maximum heat transfer with minimum weight. Rugged construction with high resistance to corrosion or electrolytic deterioration. You gain these advantages in Wilson Aftercoolers, Unit Heaters and other radiation products.



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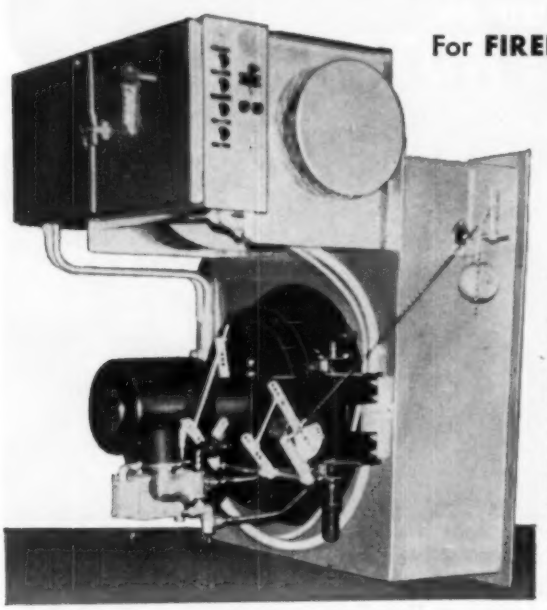

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with Burner mounted below the Control Cabinet and Blower Unit

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These Johnson Forced Draft Burners are available for firing with Oil only . . . Gas only . . . or Combination Oil and Gas. They are assembled, wired and tested at the factory, ready for inexpensive installation. They bring you smooth, high-efficiency combustion regardless of stack conditions and firebox pressure variations.

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designed especially for air conditioning and refrigeration cooling towers, booster service and coolant pumping in bulk milk coolers

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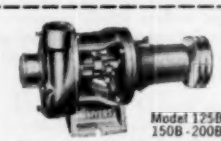
Model 125 M 150 M
Shown with stuffing box (available with rotary seal)

Model 100 M—Rotary seal only



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GAS DYNAMICS—By Ali Bulent Cambel and Burgess H. Jennings. 415 pp. McGraw-Hill Book Co., 330 W. 42nd St., New York 36. $11.00.

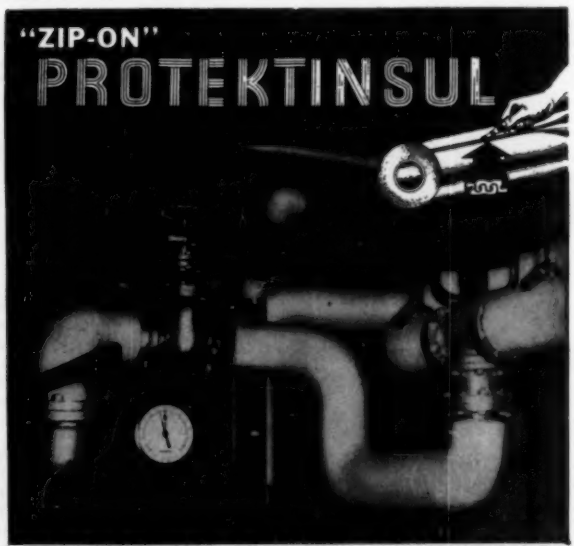
FLUID MECHANICS—By Victor L. Streeter. 480 pp. McGraw-Hill Book Co., 330 W. 42nd St., New York 36. $7.50.

PARTICULATE EMISSION—PROCEEDINGS OF THE SYMPOSIUM ON AIR POLLUTION. 105 pp. Journal of the Franklin Institute, 20th and the Parkway, Philadelphia 3. $3.00.

AGRICOLA ON METALS—By Bern Dibner. 128 pp. Burndy Library, Norwalk, Conn. $2.50.

SYMPOSIUM ON THERMAL CONDUCTIVITY MEASUREMENTS AND APPLICATIONS OF THERMAL INSULATIONS. 88 pp. American Society for Testing Materials, 1916 Race St., Philadelphia 3. $2.00.

THERMAL PROPERTIES OF THIRTEEN METALS—Compiled by C. F. Lucks and H. W. Deem. 30 pp. American Society for Testing Materials, 1916 Race St., Philadelphia 3. $1.25.



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Easy "Zip-On" installation ■ No maintenance painting ■ Excellent appearance ■ Non-inflammable ■ Chemical and mildew proof ■ Perfect vapor barrier.

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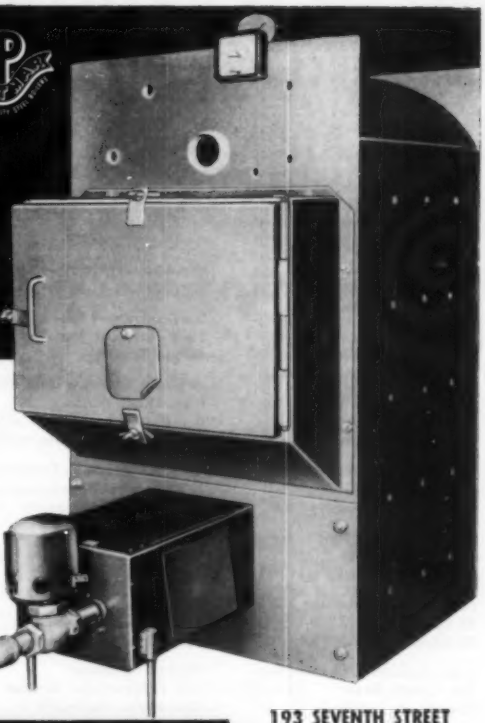
Built-in gas refractory lining requires no combustion chamber. Simply slide burner into base plate opening and pipe gas line to burner for quick easy installation.



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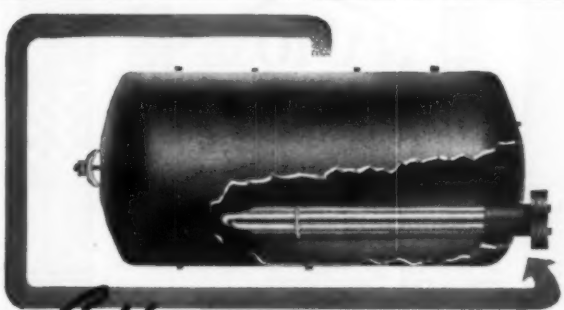

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Loosens Rust and Corrosion

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The Super-penetrating Rust Solvent

powerful blend of fast-acting solvents that literally "melts the rust away"

Works FAST!

At your wholesaler!

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NEW BOOKS & REPORTS

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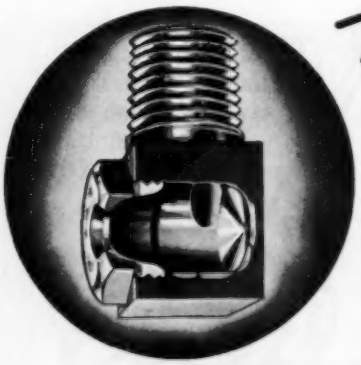
SAFETY IN WELDING AND CUTTING — 49 pp. American Welding, 33 W. 39th St., New York 18. $2.00.

SBI RATING CODE—SEVENTH EDITION. 32 pp. Steel Boiler Institute, Inc., 1308 Land Title Bldg., Philadelphia 10. $1.50.

PRESSURE LOSSES THROUGH FORCED-AIR PERIMETER FITTINGS AND SUPPLY OUTLETS—By M. V. R. Rao, Donald R. Bahnfleth and Herbert T. Gilkey. 32 pp. Engineering Experiment Station, University of Illinois, Urbana, Ill. $1.00.

UNDERGROUND INSULATED PIPING SYSTEMS—A Building Advisory Board Report to the Federal Construction Council, prepared and edited by F. A. Govan, staff engineer. 34 pp. Building Research Institute, 2101 Constitution Ave., Washington 25, D. C. $1.00

1958 ROOM AIR-CONDITIONER RATING DATA—15 pp. Air-Conditioning and Refrigeration Institute, 1346 Connecticut Ave., N.W., Washington 6, D.C. ≠



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NOZZLES
for
AIR WASHERS

These are "non-clogging" nozzles with a single large tangential lead hole to the swirl chamber that will never clog from any impurities small enough to pass through the orifice. Swirl chamber is conical on both ends and pivots liquid like a top to produce an exceptionally fine, evenly distributed, balanced spray of about 80° included angle. Wider spray angles up to 130° can be furnished to order.
Standard material Brass. Also available in Stainless Steel and Monel. Pipe sizes from ⅛" to 1". ¼" size is 1-5/16" long and made from ⅜" square stock.

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Our company is an established multi-plant manufacturer with Mid-Western general offices and doing business on an international scale. This opening represents a ground-floor opportunity in our proposed diversification program.

The bachelor's degree, 12 years experience and a thorough knowledge of the field constitute the minimum requirements. Salary will be commensurate with proven ability. Benefits include company paid hospitalization, life insurance, retirement and profit-sharing.

Submit complete resume in confidence to Key 1358A, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

Assistant Professorship in mechanical engineering with training and experience in heating, ventilating, refrigeration, heat transfer and thermodynamics. Emphasis on undergraduate laboratory work in these areas. Write to: Norman O. Gunderson, Head, Division of Engineering, San Jose State College, San Jose, California.

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Professional representation available, exclusively selling wholesalers in Western Pennsylvania, Eastern Ohio and West Virginia. Plumbing, warm air and wet heating, ventilating and air conditioning accessories or main lines considered. Boilers and burners excepted. Frequent coverage and excellent following with reputable wholesaler accounts. The Guydon Company, 217 Macassar Drive, Pittsburgh 36, Pennsylvania. Attention: Don C. Zinter.

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MANUFACTURERS' AGENTS — Territories available in Connecticut, Idaho, Illinois, Kansas, Kentucky, Montana, Nebraska, New Jersey, New York, Ohio, Pennsylvania, Tennessee, Wisconsin, Wyoming, for men experienced in selling central plant conditioners, multizone units, coils, etc., in the mechanical contractor field. Write Thermal Engineering Corp., Manufacturers, P. O. Box 13254 Houston 19, Texas (See our advertisement this issue.)

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The products include axial flow and tubeaxial fans, both direct and belt driven, and power roof ventilators. Please reply Key 1361A, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

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(COMBUSTION)

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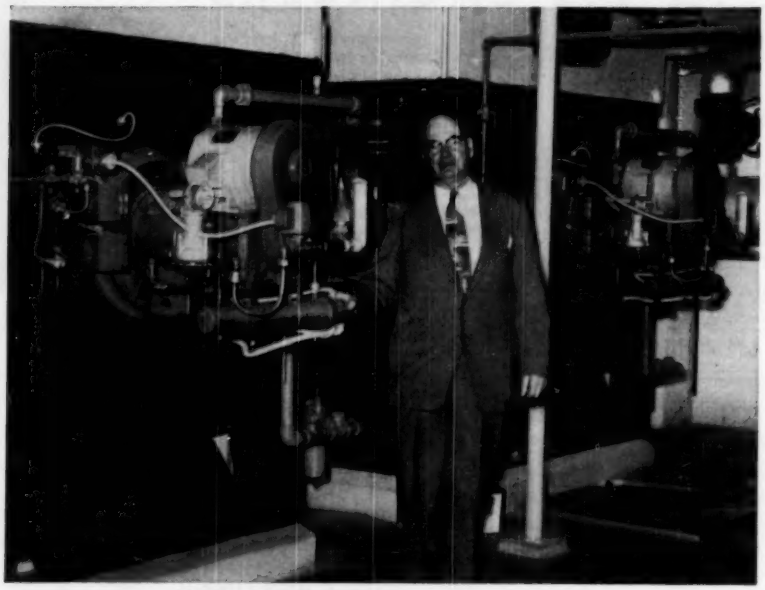
Please send details of your education and experience to Glen D. Smith, R. R. Donnelley & Sons Company, 350 East 22nd Street, Chicago 16, Illinois. All applications will be treated in strict confidence.

SITUATION WANTED

AVAILABLE: Graduate Mechanical Engineer, Zurich, Switzerland, 1950, Turkish National, age 35 — married, speaks fluent German, English and French. Past five years have specialized in industrial refrigeration and air conditioning as related to food processing field. Working since 2 years heating, ventilating and air conditioning private firm. Complete layouts, specifications and erection background. Can start in 30 days. For complete brochure write to Key 1360A, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

"I've handled the ENTERPRISE line for 12 years. They're still the best burner buy!"

Says Al Wilcox, Enterprise Burner Distributor, Seattle, Wash.



Mr. Wilcox and the two Size K-3 Enterprise Oil Burners installed at Asa Mercer Jr. High School, Seattle.

Engineers, Contractors, Users—all agree:

"Everyone Benefits When It's an Enterprise!"

"As a long-time Enterprise dealer," Mr. Wilcox writes, "I know the advantages to all concerned of installing the best oil burner made—an Enterprise.

"Engineers and contractors benefit because Enterprise delivers high performance so uniform that burners are frequently specified as 'Enterprise or equal.'

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"And by supplying the top quality burner all groups want, the dealer benefits—through satisfied customers, little servicing, and excellent relations with the Enterprise factory people."

You're bound to agree with Mr. Wilcox, too. Just check the complete range of Enterprise Burner sizes shown here. If your specifications fit, your best buy is an Enterprise. Get all the facts, today!

HORIZONTAL ROTARY OIL BURNERS, & COMBINATION OIL & GAS BURNERS

INPUT				OUTPUT		
Burner Size	Motor HP	Oil-GPH Max	Gas CF/HR	Steam LBS/HR	Steam BHP	Radiation-Sq. Ft. Steam
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A	½	7	1050	812	23	3280
C	½	15	2250	1740	50	7050
E	½	20	3000	2320	67	9400
F	¾	30	4500	3480	100	14100
G	1	35	5250	4060	118	16400
H	1	50	7500	5800	168	23400
H	1½	60	9000	6960	201	28200
J	2	75	11250	8700	250	35250
K	3	100	15000	11600	336	46900
L	3	135	20250	15660	453	63400
M	5	200	30000	23200	672	94000

The Choice of Heating Experts

ENTERPRISE

DEPENDABLE BURNERS

ENTERPRISE ENGINE & MACHINERY CO. • 18TH AND FLORIDA STS., SAN FRANCISCO, CALIFORNIA

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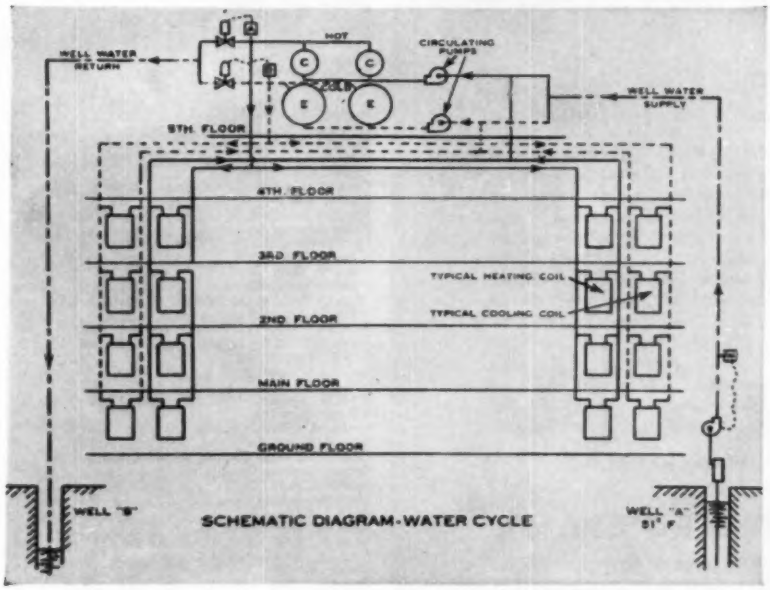
Field reports about AIR CONDITIONING

Successful installations using Freon refrigerants*



SCHEMATIC DIAGRAM-WATER CYCLE

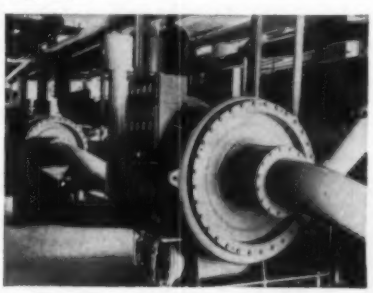
Circulating system uses feed-back principle to minimize water use under normal heating or cooling conditions

A unique feature of heat pump air conditioning for the Tacoma City Light Administration Building is the efficient use of available water supplies. Under moderate conditions heating loads virtually equal cooling loads. Under these conditions cooling side and heating side operate as closed circuits. For example, water returning from cooling coils is picked up and delivered to the evaporator unit. From there it passes to the supply side of the cooling coils. The same process goes on in the heating side. Outside water is needed only to maintain balance during more extreme heating or cooling conditions.

After one year of operation, this heat-pump system proved to be most efficient and economical for use throughout the year.

Favorable power rates, balanced heating and cooling loads justify heat-pump installation

When seasonal heating and cooling loads are approximately equal, a heat pump can be the most economical way to condition a large building. This was especially true at the Tacoma City Light Administration Building, Tacoma, Washington, because low-cost electrical power and water were available at the building site. Initial cost of the heat pump was higher than conventional systems, but combined heating and cooling operating cost is actually one-third less than the operating cost of another system of comparable size supplying only heat.



The heat-pump system consists of two 150-ton Trane CenTraVac units (shown above), which heat or cool water as required for distribution to coils on each floor. Water cycle (shown at left) is designed to use very little well water under moderate conditions. A roof-mounted fan unit delivers 150,000 cfm of filtered air to the system.

The refrigerating system is charged with "Freon-113" refrigerant, chosen because of its proven safety, over-all economy and trouble-free performance.

How Du Pont leadership in refrigerants means better performance for installations you plan

Today's more compact, more efficient equipment has grown in part from Du Pont's pioneering in development and manufacture of improved "Freon" refrigerants. Improved manufacturing techniques developed by Du Pont make "Freon" the refrigerant that sets the industry's standards for purity and performance. That's why you can be sure the installations you plan will deliver better performance when charged with "Freon". You can't select a better refrigerant than safe, acid-free, dry "Freon" refrigerant.

For complete information on applications, performance and properties of "Freon", write: *E. I. du Pont de Nemours & Co. (Inc.), "Freon" Products Division 136, Wilmington 98, Delaware.*

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...THROUGH CHEMISTRY

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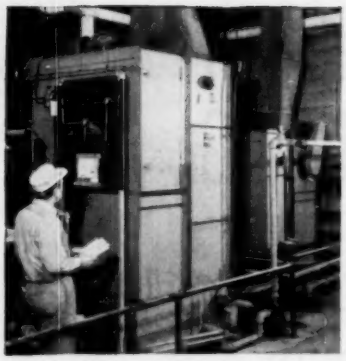
DRY and CLEAN AIR at the RIGHT TEMPERATURE

- to control your product quality
- to protect a critical operation
- to protect apparatus from moisture damage
- to DRY your material or product
- to control packing or storage conditions
- to assure precision in testing or research
- to increase air conditioning capacity



Air Condition by the NIAGARA Method Using HYGROL Liquid Absorbent

This compact method, giving high capacity in small space, removes moisture from air by contact with a liquid in a small spray chamber. The liquid spray contact temperature and the absorbent concentration, factors that are easily and positively controlled, determine exactly the amount of moisture remaining in the air.

Most effective because... it removes moisture as a separate function from cooling or heating and so gives a precise result, and always. Niagara machines using liquid contact means of drying air have given over 20 years of service. The apparatus is simple, parts are accessible, controls are trustworthy.

Most reliable because... the absorbent is continuously reconcentrated automatically. No moisture-sensitive instruments are required to control your conditions... no solids, salts or solutions of solids are used and there are no corrosive or reactive substances.

Most flexible because... you can obtain any condition at will and hold it as long as you wish in either continuous production, testing or storage.

Write for Bulletins 112 and 131 and complete information on your air conditioning problem.

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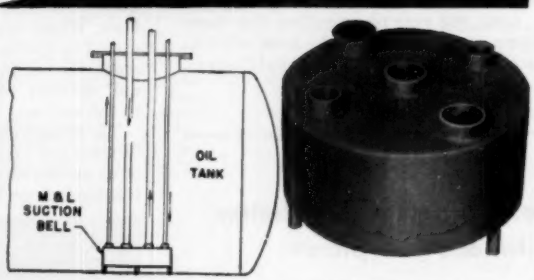

PRESCRIBED FOR ALL HEAVY OIL STORAGE TANKS

M & L Suction Bells are important accessories in any oil burning system, upon which the success or failure of the entire system may depend. Their function is to prewarm the oil in cold weather so as to permit pumping to the oil heater. They are economical units, very simply installed within the storage tank.

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ECON-GREEN-ROLL*

A DISTINCTIVE AUTOMATIC AIR FILTER THAT MERITS **YOUR** SELECTION

The Econ-O-Roll Air Filter is today's modernized version of the Green 'Sure Seal' Filter placed on the market a few years ago. The original sound basic design has been retained. The improvements are in several of the details which are described fully in Bulletin No. 176.

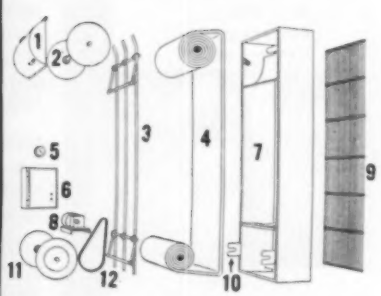
The ruggedly built Econ-O-Roll Air Filter has much to offer . . . with many operating and low maintenance values. You should give it full consideration in connection with that air filtering problem you have. When writing for literature, let us have the details of your problem.

You can have confidence in the Green Line, which for many years has included Mechanical Draft Fans, Economizers and Dust Control Equipment.

* U.S. Patents Pending

Outstanding Features Include

- *free-floating, self-adjusting seal assembly*
- *superior filtering media*
- *choice of automatic control*
- *wide capacity range*
- *simple and easy roll change*
- *few moving parts*
- *automatic 'end-of-roll' shut-off with warning light*
- *no jobsite wiring*



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2. Media Supply Shaft
3. Seal Assembly
4. Roll of Media
5. Draft Gage
6. Control Panel
7. Filter Housing
8. Drive Assembly
9. Media Retaining Grill
10. Shaft Bracket
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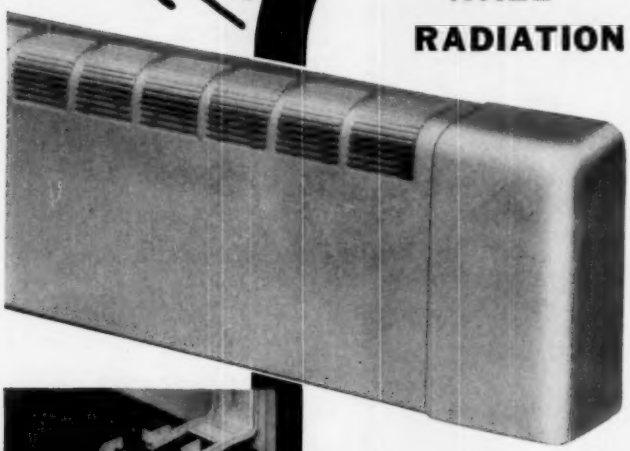
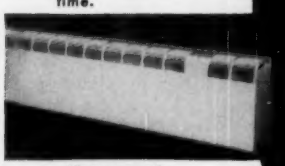
New FEDDERS Modernline

WALL RADIATION



Reversible hanger handles all element sizes.

Locking joints reduce installation time.



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MODERNLINE DESIGN... new smoothly rounded enclosures introduce Modernline styling for commercial, industrial, institutional, and multiple housing buildings.

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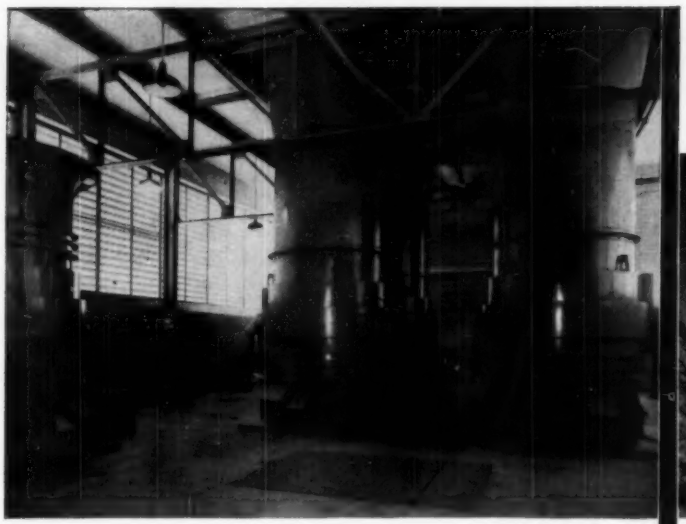

The new Hampton Roads Tunnel uses 16 Joy Axivane Fans to move 3,406,000 cfm of both fresh and exhaust air.

Compact Joy installation at Boqueron, Venezuela, moves 3,952,000 cfm of air through a 1 mile tunnel.

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JOY AXIVANE Handles the Hard Jobs

If you have a really tough ventilating job coming up . . . moving large volumes of air . . . variable pressures and volumes . . . unpredictable resistance . . . cramped space allotment . . . better take a look at the Joy Axivane Fans.

Compact design, with the motor *inside* the fan gives you more air per pound of fan and motor . . . more air per cubic foot of fan. The straight-thru design allows in-duct installation; becomes a *part* of the duct; eliminates offsets, elbows, drives and guards.

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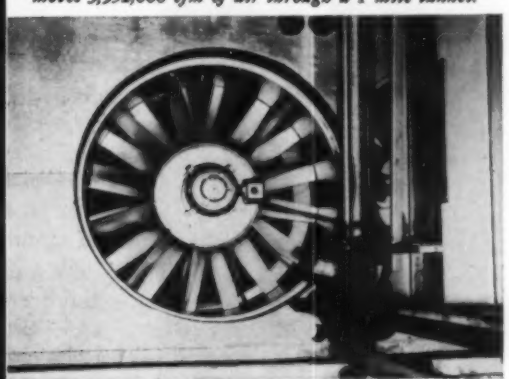
You choose from a standard line of over 136 models . . . and still have the advantage of Joy's custom engineering service. Joy Axivane Fans can make your next ventilating job a lot easier . . . one reason why Joy gets the tough assignments.



Joy Axivane design means power savings through adjust-in-motion blades at Alcoa's Texas Plant.

Dependable Joy installation circulates freezing air in California Cold Storage Plant.

WRITE FOR FREE BULLETIN 244-41

Get complete information about Joy Axivane Fans from **Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

JOY *Saves you money on AIR*

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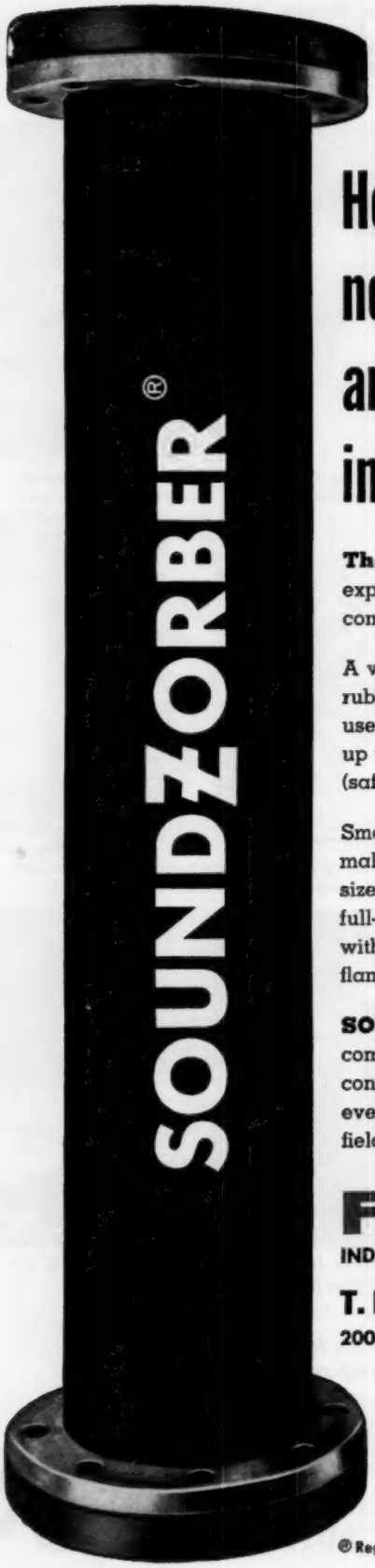

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A wire-reinforced wrapped fabric rubber pipe, SOUNDZORBER can be used continuously in water lines at up to 250 psi working pressure (safety factor: 5 to 1).

Smaller sizes ½" to 3" available with male I.P.T. bronze fittings. Larger sizes available with integral full-faced rubber flanges backed up with Series 15 or Series 30 steel flanges. No metal-to-metal contact.

SOUNDZORBER is but one of a complete line of Finn vibration controls. Finn has control devices for every vibration problem in your field. Write for complete information.

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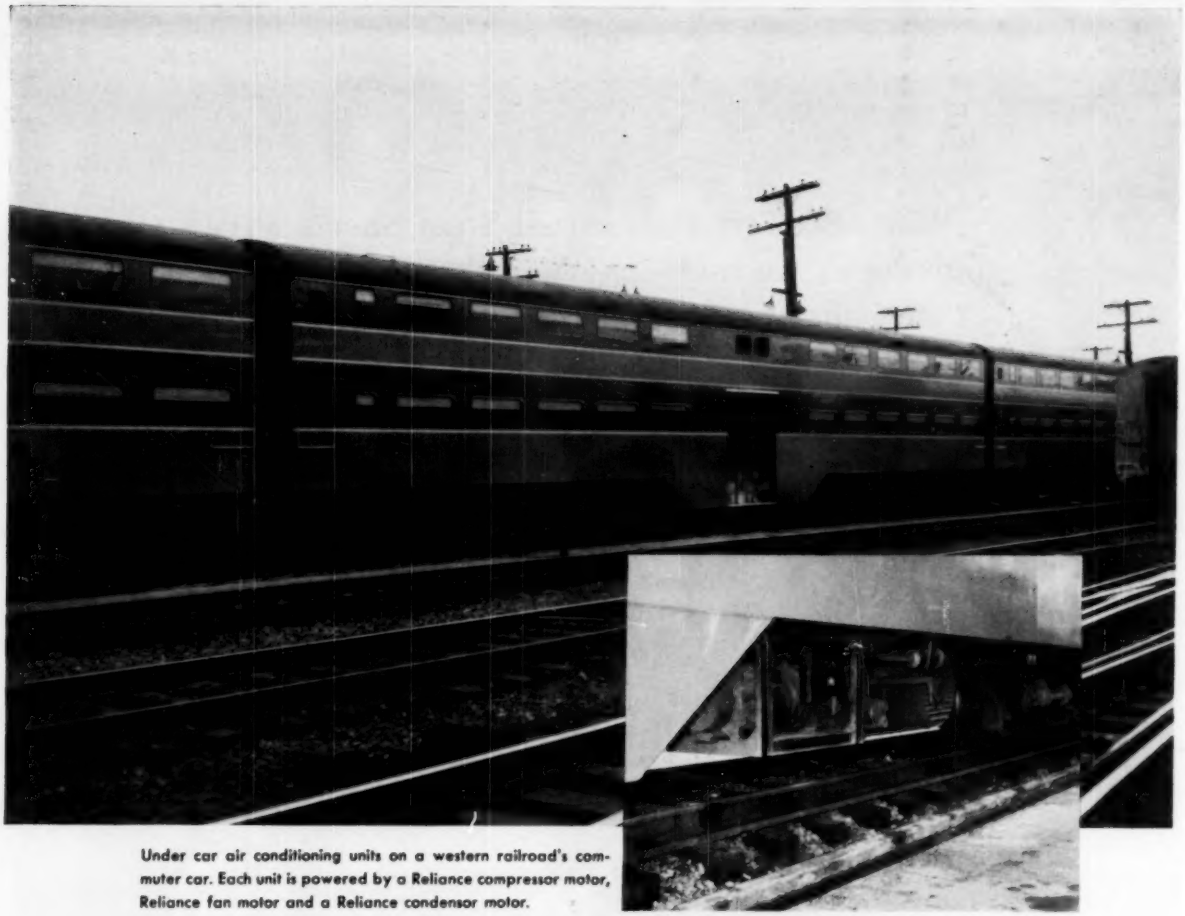
Yuba Consolidated Industries, Inc., Adsco Div. . . . . *
Yuba Water Heaters, Inc. . . . . *

Zallea Bros. 73
Zonolite Co. . . . . *

When SOFTITE Galvanized Steel Sheets were introduced, we said – *anything* that can be made of steel sheets can be made of Wheeling SOFTITE Galvanized Sheets. This challenge still stands today! For SOFTITE Sheets are easy to work . . . and have a tight galvanized coating that will not flake or peel.

IT'S WHEELING STEEL

WHEELING STEEL CORPORATION, WHEELING, WEST VIRGINIA *District Sales Offices at Atlanta, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Houston, New York, Philadelphia, St. Louis, San Francisco, Wheeling*



Under car air conditioning units on a western railroad's commuter car. Each unit is powered by a Reliance compressor motor, Reliance fan motor and a Reliance condensor motor.

You bet it's rugged service, but Reliance Motors keep these cooling units running

Track ballast, dirt, rain—nothing has altered the top performance of these Reliance Motors, even after three years of operation.

Metermatic bearing lubrication, protected windings, weather proof frames, and just plain good quality have kept these Reliance Motors going under punishing conditions.

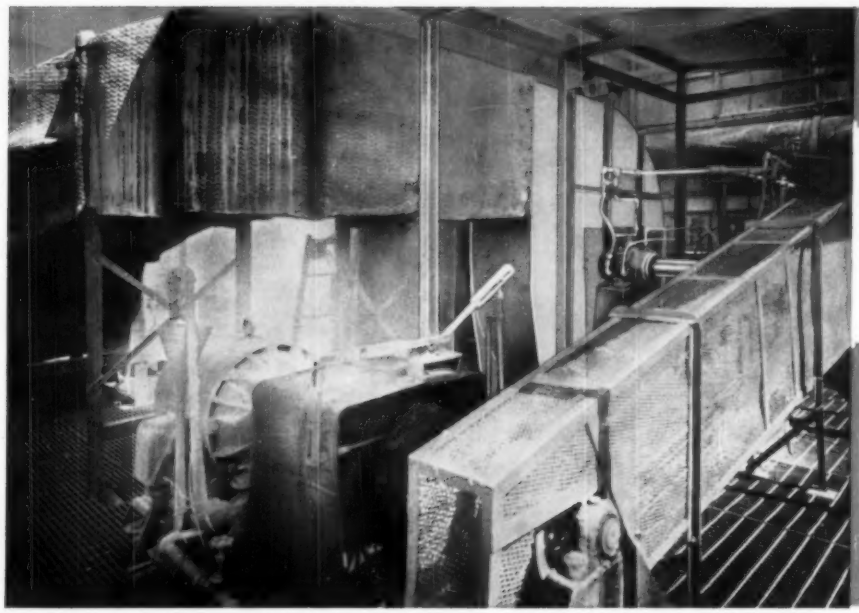
Few applications are as tough as this one. But tough or easy Reliance Totally-Protected Motors give years of trouble-free performance with a minimum of maintenance.

Get all the facts on Reliance Totally-Protected Motors from your Reliance Representative, or write today for a copy of "Check the Facts" Bulletin No. B-2401.

B-1507

RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 366A, CLEVELAND 17, OHIO
CANADIAN DIVISION: TORONTO, ONTARIO
Sales Offices and Distributers in Principal Cities



One of several Clarage Type XL Fans used in this application. Fan equipped with stainless steel wheel and V-belt driven from a hydraulic coupling.

Clarage Fans have what it takes

for this tough exhaust assignment in the production of titanium dioxide

Exhausting 800° F gases from rotary calciners through scrubber units and electrical precipitators to the atmosphere.

That's the demanding task this large chemical manufacturer gave Clarage Type XL Fans.

What kind of a job evaluation does Clarage receive? Several repeat orders furnish the answer. In fact, three additional Clarage Fans will soon be installed in a major expansion at this plant.

You, too, will find it pays dividends to choose the fan name of quality — Clarage. Call us in for capable assistance on your next requirements in the air handling and conditioning field. It's characteristic of Clarage equipment to prove out successfully no matter how exacting the application. CLARAGE FAN COMPANY, Kalamazoo, Michigan.

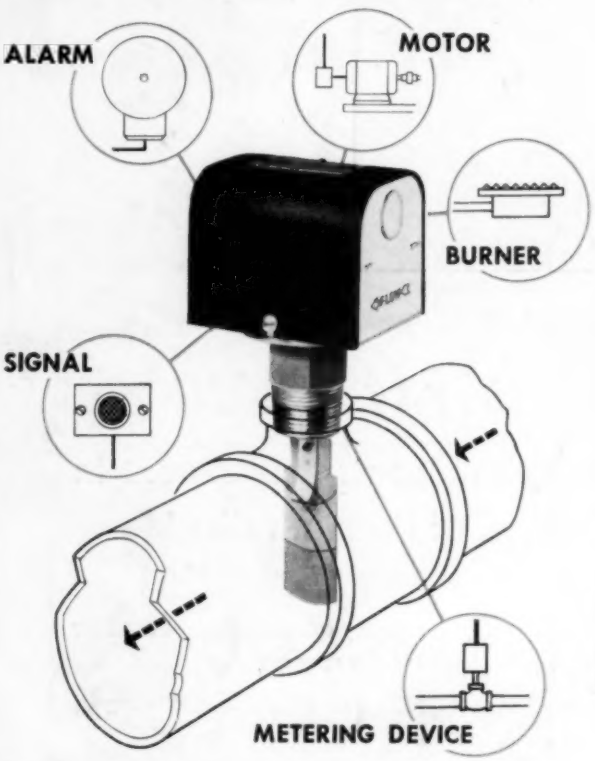
CLARAGE ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

STOP or GO according to flow!

McDONNELL FS4 SERIES FLOW SWITCHES

Versatile new way to start or stop a...



Wherever it is important to know if a flow of liquid starts or stops, right there you have a spot for the McDonnell FS4 Series Flow Switch. It is a dependable, moderately-priced device that makes or breaks an electrical circuit when flowing liquid moves the paddle. It's an effective way to provide safer or more automatic operation, available now in compact size and price to fit a broad range of applications.

Write for new bulletin Number FS-1 which shows the many possibilities this new Flow Switch offers as an automatic control or safety device.

McDONNELL & MILLER, Inc.
3500 N. Spaulding Ave., Chicago 18, Ill.

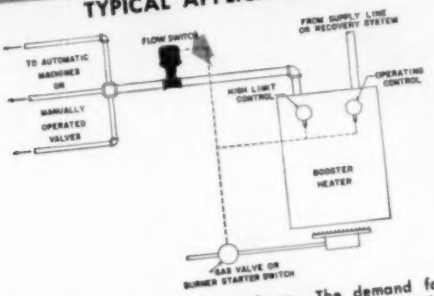
Doing One Thing Well

McDONNELL
Flow Switches

Your Jobber Stocks Them

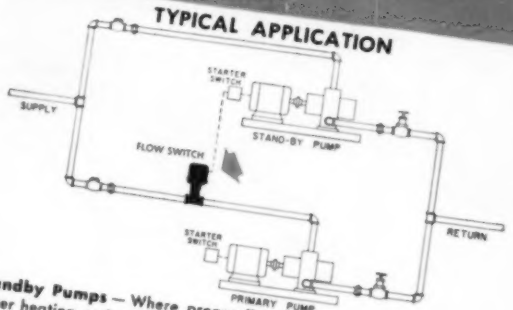
BOILER WATER FEEDERS • LOW WATER FUEL CUT-OFFS • PUMP CONTROLLERS • RELIEF VALVES • RELATED LIQUID LEVEL CONTROLS FOR TANKS, STILLS, AIR CONDITIONING SYSTEMS.

TYPICAL APPLICATION


TO AUTOMATIC MACHINES OR MANUALLY OPERATED VALVES
FLOW SWITCH
FROM SUPPLY LINE OR RECOVERY SYSTEM
HIGH LIMIT CONTROL
OPERATING CONTROL
BOOSTER HEATER
GAS VALVE OR BURNER STARTER SWITCH

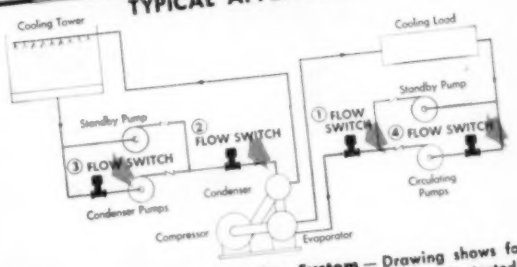
Hot Water Supply for Dishwashers — The demand for 180° water for rinsing tableware in public establishments (and for other commercial processes) frequently requires a booster heater. But the operating control on such a heater may not respond quickly enough, when a sizeable volume of water is drawn, to keep water from falling below 180°. With a flow switch in the line burner is started immediately when a draw of water occurs, to start recovery at once. When flow stops, flow switch returns control to the primary control.

TYPICAL APPLICATION



Standby Pumps — Where proper fluid flow is essential — as in hot water heating and chilled water cooling systems — a standby pump is often installed in parallel with the primary pump. In the system above, a reverse acting flow switch (breaks current with flow) is installed in discharge line from primary pump. If pump fails, and flow stops, flow switch cuts in standby pump.

TYPICAL APPLICATION



Chilled Water Air Conditioning System — Drawing shows four flow switches installed in the system. The circulating pump is started in normal manner. When there is sufficient flow, and only then, flow switch No. 1 allows the condenser pump to be started. Similarly, flow switch No. 2 allows compressor to be started when there is sufficient flow of condenser water. Flow switches No. 3 and 4 have reverse-acting switches, automatically cut in standby pump if primary pump fails. Use of the flow switches in this system assures continuous operation, starts system in sequence, stops compressor if there is not proper circulation in system, can be used to report operation on central control panel.